United Nations ECE/CES/2015/8

Economic and Social Council

Distr.: General
23 March 2015

Original: English

Economic Commission for Europe

Conference of European Statisticians

Sixty-third plenary session
Geneva, 15-17 June 2015
Item 6 (a) of the provisional agenda
Outcomes of the in-depth reviews carried out by the Conference of European Statisticians Bureau

In-depth review of population projections

Prepared by the Office for National Statistics, United Kingdom and Statistics Canada

The present note is the in-depth review paper on population projections. The Bureau of the Conference of European Statisticians conducted the in-depth review at its meeting in October 2014. The purpose of the reviews is to improve coordination of statistical activities in the region of the United Nations Economic Commission for Europe, identify gaps or duplication of work, and address emerging issues.

The note summarises international statistical activities related to population projections, identifies issues and challenges, and makes recommendations for possible follow-up work.

The outcome of the review is provided in document ECE/CES/2015/8/Add.1.

GE.15-06179 (E)

1506179

Please recycle

I. Executive summary

1. The paper provides a review of the current state of the making of population projections across a number of countries and international organizations. The review is not focused on the detailed methodology of making projections, but rather on current issues around projection making. The research in this paper is entirely internet based with minimal contact with projection makers in international organizations or national statistics institutes.

2. The report looks briefly at projections made by international organizations. It then provides short summaries of projection making in sixteen different countries, giving essential information about the projections, including how they are made. Some further description is also provided for a selection of the countries.

3. The analysis shows that while the basic cohort component method is universally used there is variation in how assumptions are determined, the frequency with which projections are made and the communication of uncertainty. There appears to be no single repository that holds information on these variations.

4. A brief summary is also provided of the recent UNECE/Eurostat Work Session held in Rome in October 2013, with links to the meeting's website.

5. The report then highlights some of the issues and challenges that are faced by projection makers, including:

(a) the lack of common definitions and methodologies;

(b) the lack of consensus about what should be the horizons and the frequency of projections;

(c) the development of methods for communicating uncertainty;

(d) the growing needs for projections of variables beyond age and sex and for alternative projection models able to handle this task (such as microsimulation models).

6. The report concludes with some suggested requirements for the presentation of projections and two key recommendations:

(a) the setting up of a joint committee. The joint committee would consider the elaboration of an international "best practice" guide for population projections, providing guidelines around some of the issues and challenges that projection makers face;

(b) the instigation of a database of information about projections. The database would contain basic information about sets of projections and how they are made to help inform users. Specific suggestions for information to be collected are made.

II. Introduction

7. The Bureau of the Conference of European Statisticians (CES) regularly reviews selected statistical areas in depth. The aim of the reviews is to improve coordination of statistical activities in the UNECE region, identify gaps or duplication of work, and address emerging issues. The review focuses on strategic issues and highlights concerns of statistical offices of both a conceptual and a coordinating nature. The current paper provides the basis for the review by summarising the international statistical activities in the selected area, identifying issues and problems, and making recommendations on possible follow-up actions.

8. The CES Bureau selected population projections for an in-depth review at its meeting in February 2014. The United Kingdom's Office for National Statistics (ONS) and

Statistics Canada were requested to prepare the paper providing the main basis for the review.

III. Scope/definition of the statistical area covered

9. In the Classification of Statistical Activities (CSA), population projections are categorised under Domain 1. Section 1.1 'Population and migration' which covers: work in population and demographic statistics, topics like demography, vital statistics, population structures and growth, demographic projections, families and households (marriages, divorces, household size), migration, refugees and asylum seekers. The area excludes causes of death.

10. Population projections in this paper cover both national and sub-national projections. Many of the issues involved are similar. This review covers only partially the projections of other variables beyond the basic demographic variables of age and sex.

11. With the limited time available, the research in this paper is almost entirely internet based with minimal discussion and contact with projection makers in individual countries, other than the UK and Canada, or with projection makers in international organizations. Any errors, therefore, are the responsibility of the authors.

IV. Overview of international statistical activities in the area

12. This section provides a brief overview of the past and ongoing activities of international organizations involved in making population projections, making clear the specialisation and value added of each organization. It also covers briefly some work carried out by academic groups.

13. At the international level there are two main international bodies that produce national population projections. The United Nations produces revised population projections every two years, the latest set being 2012-based.[1] In addition around once every ten years they produce long term projections, beyond a 100 year time horizon. Periodically Eurostat independently produces sets of population projections, the latest set, 2013-based, cover the time period 2013-2080 and were published in May 2014. The methodology document for this set will be published within the next two months. They project populations by age and sex for all EU28 Member States as well as Iceland, Norway and Switzerland.

14. A number of other organizations publish population projections at a national (or higher) level including Wittgenstein Centre for Demography and Global Human Capital in Austria, to which the International Institute for Applied Systems Analysis (IIASA) contributes. IIASA have previously produced their own projections[2]. Other international organizations that have produced their own projections include – the World Bank[3,4], the US Census Bureau[5] and the Population Reference Bureau.[6,7]

[1] http://esa.un.org/wpp/

[2] See for example http://www.iiasa.ac.at/publication/more_XB-04-001.php

[3] http://data.worldbank.org/data-catalog/population-projection-tables

[4] http://siteresources.worldbank.org/SCBEXTERNAL/Resources/Population_Projections.pdf (this is a good example of an inadequately labelled document as to which set of projections it refers to).

[5] Methodology here http://www.census.gov/population/international/data/idb/estandproj.php. It is notable that each country in this set of projections may have differing base dates, depending on the data available.

15. The Database of International Statistical Activities (DISA)[8] lists very few activities in terms of planned work in international statistics related to population projections under statistical activity 1.1. The only activity is to maintain and expand a population projections database "to achieve transparency in the use of population projections within OECD." Non EU countries involved include: Brazil, Bulgaria, China, Cyprus, India, Indonesia, Latvia, Lithuania, Russian Federation, South Africa.

16. A successful Joint Eurostat/UNECE Work Session on Demographic Projections, was held in Rome in October 2013[9] following previous meetings in 2010, 2007, 2005 and 1999. As well as sessions covering the usual population projection topics of setting assumptions for each of the three components of population change (fertility, mortality and migration), sessions were held on developing areas of interest in the topic area. There was a strand on stochastic methods in population projections and the use of Bayesian methodologies. A number of countries and organizations either produce, or are considering producing, stochastic projections (see Annex A).

17. The United Nations used probabilistic methods to set the assumptions in World Population Prospects 2012 revision. They have published interactive graphs for fertility and mortality, showing for each country, a selection of the trajectories run and the resulting probabilistic ranges.[10] An example for UK fertility is shown at Figure 1. These are excellent ways of communicating issues around uncertainty to the user. However, the essentially mechanistic nature of the process is still highly dependent on the assumptions made in the models used. They will also tend to assume trends will continue indefinitely.

18. The UN has also not yet developed a probabilistic method of producing migration assumptions for use in their projections. Therefore the overall projections cannot be described as stochastic. Currently stochastic projections tend to introduce uncertainty independently into each component. Ideally stochastic projections would also need to model relationships between components. This would be particularly true for a country still going through the demographic transition from a high fertility, high mortality population to a low fertility low mortality population.

[6] A 2001 paper reviewed a number of internationally produced population projections – see http://www.demographic-research.org/volumes/vol4/8/4-8.pdf.

[7] An excellent general piece on world population projections entitled "Dimensions of global population projections: what do we know about future population trends and structures?" (2010) Lutz W and Samir KC can be found here http://rstb.royalsocietypublishing.org/content/365/1554/2779.full.

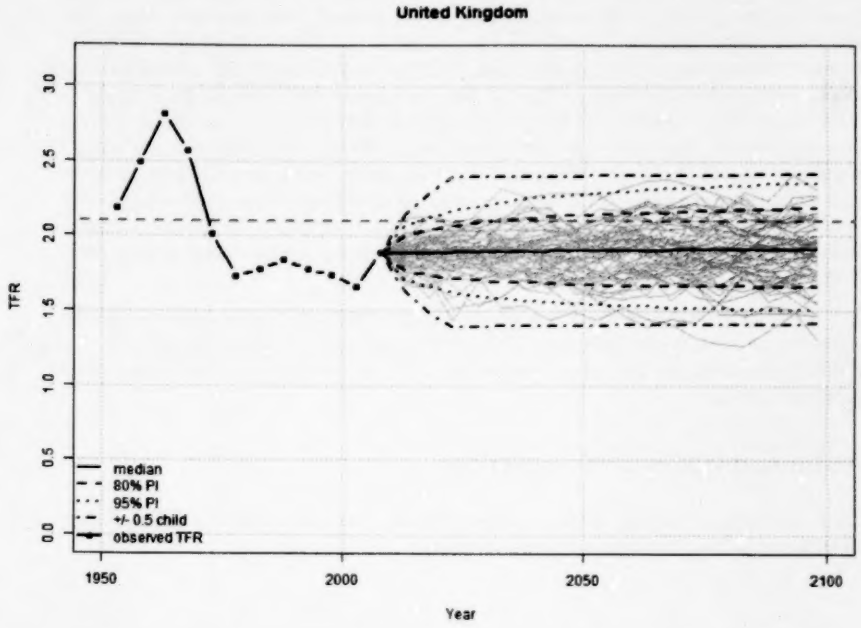
[8] http://www1.unece.org/stat/platform/display/DISA2013/1-+Demographic+and+social+statistics.

[9] http://www.unece.org/stats/documents/2013.10.projections.html.

[10] http://esa.un.org/wpp/fertility_figures/interactive-figures_TF-trajectories.htm.

Figure 1

An example page from the United Nations World Population prospects 2012 revision showing the results of the probabilistic assumptions for fertility, United Kingdom



Source: United Nations, Department of Economic and Social Affairs, Population Division (2013): World Population Prospects: The 2012 Revision, New York
http://esa.un.org/wpp/fertility_figures/interactive-figures_TF-trajectories.htm.

Explanation: These charts are from the Bayesian Hierarchical Modelling of total fertility that has been carried out with fertility estimates from the 2012 Revision of the World Population Prospects. Please note that only a small selection of the probabilistic trajectories of total fertility is displayed (gray lines) for illustration. The model is using 60,000 trajectories of projected total fertility. The median projection is the solid bold red line, and the 80% and 95% projection intervals are displayed as dashed and dotted red lines respectively. The high-low fertility variants in the 2012 Revision correspond to +/- 0.5 child around the median trajectory displayed as blue dashed lines. The replacement-level of 2.1 children per woman is plotted as green horizontal dashed line only for reference.

19. The 2013 Rome conference included sessions on projecting households and also on inclusion of additional population characteristics in projections. The centre piece of the conference was the reporting on a new set of world population projections incorporating components determined using level of education. This allowed both projections by education but also the influence of education to be played out in the assumptions. The approach is based on an evaluation of 500 international expert views. The projections do not confirm the common perception of a rapid increase in the number of migrants and suggest a shift in the education composition of migrants toward higher level of education attainment. The projections also suggested the world population would peak at 9.5 billion, not reaching the 10 billion projected by the UN.

20. Discussions highlighted that while differentials in education are clear for mortality, the issue is more complicated for fertility. Sensitivity of the results to assumptions and assessment of the performance of the projections were also discussed.[11]

21. All the projections above have so far been produced at the national level. Eurostat produced sub-national population projections as part of their 2008-based projections. This ambitious project produced population projections at the NUTS2 level for the EU-27 Member States, Norway and Switzerland. The projections show that population may increase in around two thirds of NUTS2 regions between 2008 and 2030. However, in 2030, slightly more than half of the regions are projected to continue to show an increase their population. The following caveat was given "Population projections are what-if scenarios that aim to provide information about the likely future size and structure of the population. Eurostat's regional population projections scenario is one of several possible population change scenarios at regional level based on assumptions for fertility, mortality and migration."[12] Eurostat are planning to produce a new set of sub-national projections in 2015.

22. Trying to produce a consistent set of projections across a large number of countries below the national level of geography is difficult as, not only do you have to project within country migration, all the other components need to be split by those lower level geographies too.

V. A summary of country practices

23. A country by country breakdown and a table at Annex A summaries key information about the projections from the following countries:

- Australia*
- Belgium
- Canada*
- Denmark
- Finland
- France*
- Germany*
- Italy*
- Netherlands*
- New Zealand*
- Norway*
- Portugal
- Spain*
- Switzerland
- United Kingdom*
- USA*

[11] http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.11/2013/2013_Demographic_Projections_long_report_formatted_PV.pdf.

[12] http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-SF-10-001.

For those with asterisks web links and further information have been provided. The methods and practices of producing projections of the population across these countries present a number of issues and challenges.

VI. Issues and challenges

24. There are many issues and challenges in producing population projections. These can broadly be grouped into methodological challenges and practical issues, the latter particularly around the use of projections and communication of uncertainty/utility.

A. Methodological challenges

1. Stochastic methods, expert opinion and communicating uncertainty

25. In a panel study of world population projections, the National Academy of Sciences concludes the following as the greatest needs: more reliable baseline data; quicker updates to projections following new information; and, acknowledging uncertainty and developing methodologies to quantify it.[13]

26. In the current state of affairs, there is no scientific consensus on the best ways to proceed for estimating and communicating the uncertainty associated with projection exercises. It is a current topic of research and should remain so.

27. Alongside mathematical/statistical extrapolation methods, two key approaches in helping to set assumptions have come to the fore in recent years. To produce stochastic projections some demographers have gone down the Bayesian statistics route, often using past variations in population, or past projection errors, to inform their models. Others have preferred Delphi style methods using large groups of experts to produce stochastic projection assumptions.

28. The communication of uncertainty is useful for planners to assess risks associated with projects. However, just because either method is able to do this does not necessarily mean they are any better at correctly foreseeing the future. Measures of uncertainty based on past projection errors can be misleading when the demographic contexts differ or when the methods or the teams responsible for making the projections have changed. Measures of uncertainty based on past variations (such as time series) depend greatly on reference period used and the past demographic context. Finally, the use of expert opinion carries risks that knowledgeable and experienced projection makers may end up with a narrower range of uncertainty than is realistic, as they will be familiar with past assumptions. Experts may a form an opinion that converges towards a "correct" answer when actually that correct answer is just a reflection of past projection assumptions rather than giving true insight into future trends. As an example, experts have been found to consistently underestimate improvements in mortality. Further, it can be difficult to decide how to weight each opinion. Generally Delphi type questionnaires will ask people to identify their own expertise. Modesty or ego may affect such data.

29. The communication of uncertainty is not an easy task. It should be done in a way that it does not encourage the interpretation of projection results as predictions. Moreover, some of the more complex stochastic models may also be hard to communicate to the average user and may seem little more than a 'black box' approach.

[13] National Academy of Sciences. 2000. *Beyond Six Billion: Forecasting the World's Population.* Eds. J. Bongaarts and R.A. Bulatao. National Academies Press. 258p.

30. Communication of uncertainty through the use of variant projections or stochastic methods is less likely to be found in the production of sub-national population projections. This is likely to be because these projections tend to be for shorter time horizons, but also because of their greater level of complexity. However, the presence of smaller populations at the sub-national level and the additional component of interregional migration, which are often volatile, are strong arguments (where applicable) pointing towards the importance of communicating uncertainty using variant scenarios.

31. Stochastic style projections at least inherently show that there is a range of possible futures. Other ways of showing this are to make plausible alternative assumptions for each of the components (which is what the UK and Statistics Canada currently do). The individual effects of the alternative high or low assumptions can be demonstrated but they can also be combined to produce such variants as high/low populations, or young/old populations. Any communication of uncertainty needs to consider how the uncertainty increases over the length of the projection. Uncertainty around components is often almost symmetric, the possibility that uncertainty is asymmetric should be considered – although that can be more difficult for users to understand. It should not be forgotten as well that a further source of error in any projection can be the base population and any assessment should take account of any changes made to the base, or any inherent uncertainty in the base estimate.

2. Assessing population projection methodologies

32. There is a genuine methodological challenge to try and assess the success of different methodologies. The nature of projecting several decades into the future is that it is only several decades into the future that you can see how successful the projections were. One might consider applying the methods to data from several decades past (assuming it was available) and seeing if it can predict the present. While past success may be no guarantee of future success, historical time series of demographic data are becoming sufficient to carry out this type of analysis.

33. Some have questioned the value added, in terms of projection accuracy, of the cohort-component method over extrapolation and 'naïve' methods which are comparatively simpler and less costly to produce.[14] However, the cohort-component method holds at least two main advantages over simpler methods. Firstly, the structure of the cohort-component method mirrors and thus extends the structure of the data produced by national statistical agencies. Secondly, it allows for the elaboration of specific assumptions for each of the components of growth, facilitating an evaluation of the plausibility of said assumptions.

34. A crucial component of the quality of a projection exercise is the utility of the exercise as perceived by its users at the time they are made available. Thus, the quality of a projection exercise might relate more to its utility in the present, rather than in the future. Thus, the adoption of a given methodology based on the power of its accuracy should be weighed against other aspects such as its ease of interpretation and use, timeliness and cost.[15]

[14] See for instance: Rayer, S. 2008. Population Forecast Errors: A Primer for Planners, Journal of Planning Education and Research, 27: 417-430; and Tayman, J. and D.A. Swanson. 1996. On the utility of population projections. Demography 33(4): 523-28.

[15] See for instance: Yokum, J. Thomas, and J. S. Armstrong. 1995. Beyond accuracy: Comparison of criteria used to select forecasting methods. International Journal of Forecasting 11: 591-97; and Rayer 2008, ibidem.

35. In the context of population projections, it is the plausibility of the assumptions more than the outcomes themselves that should be evaluated.[16] The utility of a population projection is not in the future, it is in the present, as a tool to raise questions about the future.

36. A recent survey of European statistical agencies regarding their population projections program indicates that all statistical agencies see a need for improvement in the methods used to make assumptions; specifically, advancing the conventional methodology of scenario-based forecasts (stochastic/probabilistic forecasting methods, in contrast, did not appear to be a high priority for the majority of agencies). Other commonly-cited needs were a) greater expert involvement in the development of the projections and b) greater communication and more structured interactions with other national statistical agencies regarding their assumptions and methodologies[17,18].

3. Making assumptions

37. Generally the use of the cohort component method of ageing on population, adding projected births (generated via projected fertility rates) subtracting projected deaths (generated via projected mortality rates) and adding net migration (which may be either assumed numbers, either gross or net, or rates/probabilities) is universal. However, the methods of projecting the components may vary greatly.

38. It is possible to look at trends, particularly for fertility and mortality rates, on a period or cohort basis. And when projecting trends decisions need to be made as to:

- whether to continue trends indefinitely;
- the historical period the trends are taken from;
- whether to incorporate other characteristics or correlates into the setting of the trends, for example, should cause specific mortality be analysed to generate future mortality trends; and
- whether trends are derived purely from mathematical modelling or by the application of expert judgement – or a combination of the two.

39. Methods may be varied if the intention is to produce projections by age, sex and other characteristics. For example, to produce projections of the ethnic population it may be that additional assumptions are needed on transitions of people between ethnic categories based on changes in self-definition, or on differentials for some demographic behaviours - for example, higher or lower fertility among specific sub-groups of the population. Decisions also need to be made as to whether individual rates are produced by the variable concerned or whether proportions are applied to populations initially projected from the whole population. The US, for example, produces its population projections by assuming different rates for five different race or Hispanic groups.[19] Here they have

[16] Romaniuc, A. 2003. Reflection on Population Forecasting: From Predictions to Prospective Analysis. Canadian Studies in Population 30(1): 35-50.

[17] Prommer, I. and C. Wilson. 2006. An analytical summary of the current practices of definition of assumption making in population projections. International Institute for Applied Systems Analysis. Work Package 3, Deliverable D14. Contract no. SP23-Ct-2005-006637.

[18] Further on the topic of expert involvement, IIASA has recently developed an "argument-based approach" to surveying demography experts around the world about their views on future demographic trends. The exercise provides a model of a novel, systematic approach to developing projection assumptions (for more details, see: Lutz, W. 2009. Toward a systematic, argument-based approach to defining assumptions for population projections, Interim report IR-09-037. International Institute for Applied Systems Analysis.).

[19] http://www.census.gov/population/projections/files/methodology/methodstatement12.pdf.

individual rates for each of the groups but there is obviously no transition between groups.[20] A general principle, however, is that if you have to project a variable that is even harder to project than the population – for example, economic growth – then incorporating that variable into the projection of population is probably not worthwhile.

4. Top down or bottom up?

40. A key methodological issue often not considered is whether to produce population projections where a number of geographical areas are involved in a top down or bottom up way. For example, the Eurostat projections are produced in a bottom up way by applying their methodology to each of the countries and then adding the resulting projections together to get a figure for the EU in total. It would be possible to put together all the data and apply the methods to the total EU population and run the projection. The individual country projections could then be constrained to this total. There is scope for further research into this area.

41. This is also a question for individual countries to consider when thinking about sub-national projections. Statistics Canada, for example, employs a "hybrid bottom-up" approach to their projections, whereby target assumptions are first made at the Canada level and from that, assumptions are derived at the provincial and territorial level so as to sum to the desired national targets. A drawback of this approach is that the observed trends for individual sub-national regions may be eschewed when they differ considerably from the national average; however, in some cases this relates more to the volatility of trends in regions having very small population.

42. There is also an interesting methodological conundrum as to when the cohort component method may either cease to become robust – either because of the data requirements or because stochastic processes may start to intervene – for example when projecting very small areas or populations.[21] It may be that in these cases stochastic or probabilistic methods projecting the whole population outside the cohort component method are appropriate.

B. Practical issues

1. Terminology - projections or forecasts

43. Official projection makers tend to refer to their figures as projections rather than forecasts. To the lay person this debate may feel like semantics and to the user planning services or distributing budgets it is probably immaterial. The Australian Bureau of Statistics attempts to define the difference as follows[22]:

[20] Other projection techniques such as microsimulation methods can handle these transitions in an efficient way.

[21] For example work has been carried out to look at the smallest population for which calculating a lifetable is robust – see *Life expectancy at birth: methodological options for small population* National Statistics Methodological Series No.30 Barbara Toson and Allan Baker, Office for National Statistics,. http://www.ons.gov.uk/ons/guide-method/method-quality/specific/gss-methodology-series/index.html.

[22] http://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language+-+estimate+and+projection.

Type of information	The difference	Nature of assumptions
Projections indicate what future values for the population would be if the assumed patterns of change were to occur. They are not a prediction that the population will change in this manner.	While both involve analysis of data, the key difference between a forecast and a projection is the nature of the assertion in relation to the assumptions occurring.	A **projection** simply indicates a future value for the population if the set of underlying assumptions occur.
Forecasts speculate future values for the population with a certain level of confidence, based on current and past values as an expectation (prediction) of what will happen.		In a **forecast**, the assumptions represent expectations of actual future events.

44. One might argue that, for most projections where expert judgement is used alongside statistical extrapolation the projected components of fertility, mortality and migration are, in fact, forecasts. However, even in this situation as projection makers are interacting three 'forecasts', the result is effectively a projection. Much depends on the view of each of the assumptions made – including the sophistication of the analysis, the use of expert opinion and whether for the components the projection maker is speculating on the future trends in the components with a certain level of confidence. For sub-national projections the derivation of the component assumptions tends to be mechanistic and if this is the case the results are certainly projections and not forecasts.

45. A related issue is the fact that, despite the effort which agencies may make to distinguish between a forecast and a projection (i.e., through the use of multiple scenario variants, none labelled "most likely"), users inevitably turn to the middle variant and interpret it as a forecast and/or the scenario the most likely to occur. Keyfitz[23] questions which criteria should define a projection versus a forecast: is it the demographer's intention or the reader's use? Demographers in the process of building projection assumptions inevitably find themselves attempting to assess what outcomes are the most likely to occur. Therefore, the notion of predicting the future is subtly embedded within the projection assumption-building process.

2. Issues around the availability and comparability of many projections

46. A particular issue with projections (although it can happen for estimates, or even for data counts if there are definitional issues) is that comparisons of projections can be difficult. If a user wanted to compare population projections for two European countries for 2030 they would have the choice of a number of different sources – they could look at the countries' own statistical office's (NSO) projection, they could look at the Eurostat projections, they could look at the UN projections – or they could find projections by one of the other international bodies. Some knowledge may be needed to determine which numbers are appropriate. It is likely that for a developed European country the NSO projections will be produced using some expert knowledge and a sense for which methods those experts think work best for that country. However, the methods could be very different and the base year may be different. Projections by international bodies will tend to use the same base year and the same methodology but they may be more out of date and the methodology may be less sophisticated, as it needs to be applied to a large number of

[23] Keyfitz, N. 1972. On future population. Journal of the American Statistical Association 67(338): 347-63.

countries. It also may contain assumptions about trends continuing or attenuating that would not be applicable to the individual country but are sensible in terms of producing the projections as a whole.[24] It is only by understanding the projections assumptions and methodology that a user could decide which figures provided the best comparison for their use. It is vital, therefore, that information on the assumptions made is available and ideally NSOs should produce documents comparing their projections with those produced by international bodies. Where possible, international bodies should discuss the resulting assumptions from their methodologies with national NSOs to ensure that the assumptions do not produce completely unacceptable results.

47. The issue described above may be mirrored when projections are made across regions within a country. In the UK, Wales has produced a 2011-based set of sub-national projections that are not constrained to any national projections.[25] The publication is careful to only publish the figures for the local authorities in Wales, without adding up the figures to a total which would be different from the national population projection (in fact no 2011-based national projections were made for Wales).

48. The plethora of projections produced means that it is important that basic labelling of the projections includes the base year (including the point in the year) – something about the status of the projection (is it a main or principal projection or is it a variant), the name of the producer of the projection and whether it has been made consistent with any other projection.

49. The production of a best-practice guide for population projections would improve the comparability of different sets of population projections, ensuring common principles with regards to horizon, number of scenarios, dissemination and documentation.

3. How far forward should projections look?

50. Uncertainty increases the further into the future projections are made. So another practical issue is how long to actually run the projection for. Once projection models are projecting the demographic behaviour of a population that is already a projection (that is, you are projecting the fertility behaviour of women who themselves are not yet born) the results are even more uncertain. Thus projection makers tend to only project 60 years or so forward. By then all those under 60 in the population will have been projected.

51. In their review of current world projections, the National Academic Press suggests that beyond a period of 50 years, forecasts involve so much uncertainty that they should not be produced.[26]

52. A related issue may be the level of detail published further into the future. Both these issues may impact on users in that projections may not go to the horizon they need – for example, long-term planning of pension benefits. The different projection horizons, or decisions about levels of detail published, can make comparisons of long-term projections difficult.

53. Population projection users are interested in different time horizons – some may need to know many decades ahead, for example for housing planning, others may only need to know a few years, for example, for resource allocation. Projection makers need to

[24] A good example of this is that the UN used to assume developed countries returned to replacement level in the long term. While this might have been a sensible assumption at the time it was becoming increasingly unlikely for a number of European countries.

[25] http://wales.gov.uk/docs/statistics/2013/130723-local-authority-population-projections-2011-based-en.pdf.

[26] The National Academies Press. 2000. Beyond Six Billion: Forecasting the World's Population. Eds. J. Bongaarts, and R.D. Bulatao. National Academy of Sciences. 258 p.

consider this in the design of the methodology and the frequency with which projections are produced. They also need to consider this in the communication of any uncertainty – ensuring sufficient uncertainty is shown in the short term as demographic trends can vary substantially in short-time periods, both nationally but particularly at lower geographical levels.

4. How often should projections be made?

54. The frequency with which projections are made is also a practical decision (although it might be argued that if a measure of stability in the projections could be derived there is also potentially a methodological solution to be found here – although the methodology itself, including how sensitive it is to recent change will influence that stability). Infrequent projections tend to lead to large changes between projections deriving from big changes in all the components. This means that users may use out of date projections for quite some time. Equally, producing new projections every year – perhaps with quite minor changes – may frustrate users, who have to constantly update their work and, given that all projections are to a greater or lesser extent wrong, excessive production may just give a spurious sense of accuracy. Generally the frequency of projections made by national statistics institutes varies between two to five years although some have longer gaps.

55. Although some periodicity is needed (to ensure that knowledge is retained in national statistical institutes, to plan for resourcing in national statistical agencies and to give users expectation of when new projections will be available), the commitment of national statistical agencies to revise projections when the demographic situation has changed significantly could give users greater confidence in the projections produced.

5. Data quality and definitions

56. A further practical issue (although potentially one that may need methodological solutions) is the availability of data and the quality of that data. International organizations such as Eurostat and the UN have processes to try and produce consistent data series on consistent definitions, and have had in place an international data collection system to minimise burden on data provision by individual European countries.[27] However, definitional differences, for example, in who are counted as migrants, can have an effect on subsequent projections. Leaving aside the philosophical issue of whether projections are projecting the population estimates, including their definitional issues and flaws, or project the 'truth' it is vital that documentation of definitions is included alongside methodology.

57. A final challenge, which comes under both the practical and methodological headings, is the increasing importance of migration. Migration is complex as it has to be defined, and there can be a number of different dimensions that can be of interest to those using demographic estimates and projections. Migration, either international or subnational, can also be highly volatile, making it more difficult to develop assumptions about. Finally, the choice of the methodology used for the projection of migration tends to greatly impact the results (for example, using the multiregional model versus predetermined nets).

6. Needs for projection of variables beyond age and sex

58. There is an increasing demand for projections of sociodemographic variables beyond age and sex. This demand is likely to continue to grow in the future. For example, education is considered to be a key factor in determining how industrialized countries will overcome the challenges related to population aging or to climate change.[28] The importance

[27] http://unstats.un.org/unsd/demographic/meetings/egm/DYB_1103/docs/no_08.pdf

[28] For instance, in a recent report from the National Research Council, Wolfgang Lutz explain that education enhances the lives of people in many ways, citing benefits such as enhancing cognitive

of international migration in defining the composition of the national population is another factor that could boost the demand for the projection of some characteristics other than age and sex, such as foreign-born status, ethnic groups, or language.

59. Not only is there an added-value in projecting these additional variables, it can improve projections by age and sex as it allows to take into account the differentials in behavior among sub-groups of the population.[29]

60. Microsimulation has proven very powerful in the simultaneous projections of a large number of variables in Canada with the Demosim model.

61. Microsimulation models have long been used in science for forecasting, but their use in demographic projections is still rare. However, the on-going development of microsimulation models and of tools facilitating their use (such as programming language) should lead to a wider adoption and a better understanding of these techniques in the future.

VII. Conclusions and recommendations

62. The myriad uses to which population data, but particularly projections, can be put means that it is almost impossible for projection makers to take account of each stakeholder's needs – rather they must endeavour to produce the best population projections they can. However there are some specific actions which projections makers could take which would assist those who use projections.

63. All projections should be clearly labelled with the base year, the organization that produced the projection and any information about whether the projection has been made consistent with other projections.

64. The methodology used to derive the assumptions made in making the projections should be clearly published.

65. All projections should have some analysis which helps users understand the uncertainty inherent in making projections. In an ideal world there would be standard methods for describing uncertainty, however, unless projections were made with identical methods uncertainty will always be described slightly differently in each case. For projections made by the cohort component method there should be expression of uncertainty for each of the components.

66. As far as possible all population statistics, including projections should adhere to internationally agreed definitions – in particular those concerning migration.

67. National statistics institutes and international organizations that make projections should form a joint working group to periodically discuss approaches and review assumptions. Greater use should also be made of DISA to record activity. They might also want to consider providing guidance on issues such as:

---

skills, enabling better learning from past experience and promoting higher incomes. Lutz mentions that higher levels of education can improve the population's adaptive capacity to respond to climate change. *Source*: National Research Council. (2014). Can Earth's and Society's Systems Meet the Needs of 10 Billion People? Summary of a Workshop. M. Mellody, Rapporteur. Board on Environmental Change and Society and Committee on Population,Division of Behavioral and Social Sciences and Education. Board on Life Sciences, Division on Earth and Life Studies. Washington, DC: The National Academies Press.

[29] See for instance: Statistics Canada. 2010. "Projections of the Diversity of the Canadian Population, 2006-2031". Statistics Canada catalogue no. 91-551, and Statistics Canada. 2011. "Population Projections by Aboriginal Identity in Canada, 2006-2031". Statistics Canada catalogue no. 91-552.

- Length of projection horizons, including an understanding of short-term and long term;
- Communication of uncertainty;
- Assessing the efficacy of projection methods (for example when top down or bottom up approaches should be used) and assessing the performance of different projections;
- Developing a greater understanding of the users of projections.

68. The UNECE should maintain a publicly available online database of projections made by NSOs and International Organizations which includes the following basic information about the projections:

- Name of organization
- Base year of projection (including information about the accuracy of the base year – for example how far away it is from a Census).
- Date projection published
- Geography covered
- Consistency with or relation to any other projections (including any they supersede)
- Length of projection
- Level of detail produced (single age or age bands, every year or selected years, other variables)
- A basic description of the method used with links to published further details
- A brief description of how uncertainty is communicated
- A note of when projections are likely to be updated

69. The database should be searchable so that, for example, if a user wants to find the projections for a country or area they can identify all the projection runs that cover that geography.

70. The use of any such database should be monitored and ideally should include an element for stakeholders to give feedback on why they were looking for information on projections and what they want to use them for.

71. It is recommended that the international community stays abreast of further developments in microsimulation models for population projections. Such models should prove powerful to answer more complex demand for projections of variables beyond age and sex.

72. The UNECE could investigate the option of producing and disseminating a guide of best practices in population projections. This publication would stress best practices in the field of population projections regarding methodology, horizon, number of scenarios, dissemination and communication. Such a document would likely increase the comparability and quality of the population projections performed by UNECE member countries.

Annex A

A. Summary of current country population projections

Country	*Latest base point*	*Frequency of production*	*Methodology notes*	*National Horizon*	*Are probabilistic methods used and/or stochastic projections produced*	*How is uncertainty expressed for users?*	*Frequency of sub-national projections*	*Sub-national projections controlled to national projections?*
Australia	30 June 2012	Periodically, had been every 2-3 years but a 6 year gap between this set and previous set	Cohort component	To 2101 89 years	No	Three key variants produced	At state/territory level the same as national projections	Yes, but only run 2013 - to 2061
Belgium	1 Jan 2013	1 year	Cohort component	50 years	No			Yes
Canada	Mid-2013	About every five years, based on the census cycle.	Cohort-component method. Assumptions based on past trends and consultation process.	50 years for Canada, 25 years for provinces and territories.	No. Specific population projections for sub-groups of the population are available through micro-simulation.	Variant projections are produced using plausible alternative assumptions for fertility mortality and migration	Same as national.	Yes, as the "bottom-up approach" is used. Thus, Canada is computed by summing the individual provinces and territories.
Denmark	2014	1 year	Deterministic model	To 2050 (35 years)	No			

Country	*Latest base point*	*Frequency of production*	*Methodology notes*	*National Horizon*	*Are probabilistic methods used and/or stochastic projections produced*	*How is uncertainty expressed for users?*	*Frequency of sub-national projections*	*Sub-national projections controlled to national projections?*
Finland	2012	3 years	Cohort component method	To 2060 (48 years)	No			
France	1 Jan 2007	The current projections were published in 2010 Previous projections had run from 1 Jan 2005 and were published in 2006.	Cohort component, trend based assumptions	To 2060 (pub Oct 2010)	No	Through variant projections	Unclear	horizon to 2040 (pub Dec 2010)
Germany	31 Dec 2008	Previous had 2 year gap – however no projections carried out since 2009	Cohort component Use experts to advise on trends and analysis	To 2060 52 years	No	Variant projections are produced using plausible alternative assumptions for fertility mortality and migration	Projections to Länder level produced with national projections	Yes at Länder level
Italy	1 Jan 2011	Previous 4 years earlier	Cohort component	To 2065	No	2 Variants are produced for high and low populations, varying all three components.	Same as national	Projections are produced to the level of region at the same time as the national level
Netherlands	1 Jan 2013	Biennial for full set on even number base years with 'prognoses'	Cohort component with stochastic methods used	To 2060	Yes	For main projections probabilities are shown	Not clear	Not clear

Country	*Latest base point*	*Frequency of production*	*Methodology notes*	*National Horizon*	*Are probabilistic methods used and/or stochastic projections produced*	*How is uncertainty expressed for users?*	*Frequency of sub-national projections*	*Sub-national projections controlled to national projections?*
		produced on odd numbered years						
New Zealand	30 June 2011	Biennial - mainly	Cohort component stochastic model for 2011 based national set	To 2061 50 years	Yes	Fan charts	Every 5 years But update done. Latest are 2006 to 2031 Next due 2015 stochastic methods being researched for these.	Yes
Norway	1 Jan 2014	biennial	cohort component method is applied, using probabilities for all components including migration	To 2100 (86 years)	No	Variant projections are produced with variants of all components, including internal migration	Made at the same time as national projections, but latest set only projects to 2040.	Yes
Portugal	2012		Cohort component	50 years	No	4 Variants available		
Spain	1 Jan 2012	Every 3 years	Cohort-component	40 years to 2052	No	No numeric indication of uncertainty	1 year (10 year horizon)	Yes
Switzerland	1 Jan 2010	5 years	Cohort component	50 years	No	Many scenarios available	Every 5 years	Yes

Country	*Latest base point*	*Frequency of production*	*Methodology notes*	*National Horizon*	*Are probabilistic methods used and/or stochastic projections produced*	*How is uncertainty expressed for users?*	*Frequency of sub-national projections*	*Sub-national projections controlled to national projections?*
United Kingdom	Mid-2012	Normally every two years – interim sets may be produced around Census years	Cohort component method, expert extrapolation of trends in components	Focus on first 25 years – projections run for 100 years to 2112	No	Variant projections are produced using plausible alternative assumptions for fertility mortality and migration	For England same as national. Other countries of UK vary	Yes for England, Scotland and Northern Ireland.

Note: No national population projections were found for the following countries: Andorra, Armenia, Azerbaijan, Bosnia and Herzegovina, Croatia, Cyprus, Czech Republic, Georgia, Greece, Hungary, Israel, Kazakhstan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, Republic of Moldova, San Marino, Slovenia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

B. Key information about population projections

1. Australia

1. The Australian Bureau of Statistics latest projection of Australia's population by age and sex is for the period 30 June 2013 to 2101, and projections of the states, territories and capital cities/balances of state for the period 30 June 2013 to 2061. The base is 30 June 2012 and these figures are preliminary estimated resident population.

2. Three main series of projections are produced (Series A, B and C) as well as other series for analytical purposes.

3. Their website says "Assumptions have been formulated on the basis of demographic trends over the past decade and longer, both in Australia and overseas, in conjunction with consultation with experts at the national and state/territory level. They do not specifically attempt to allow for non-demographic factors (such as major government policy decisions, economic factors, catastrophes, wars, epidemics or significant health treatment improvements) which may affect future demographic behaviour or outcomes."

2. Canada

4. Statistics Canada produces population projections for Canada, provinces and territories about every five years, following the census and population estimates program cycles.

5. Statistics Canada's Policy on Estimates with Future Reference Dates states that 1) mathematical models used need to be open to public scrutiny, 2) assumptions must be clearly defined and presented, 3) more than one scenario must be made available and none should be qualified as "the most probable" 4) projections results must be reproducible.

6. Projections for Canada, provinces and territories are computed using the cohort-component method and are based on the latest population estimates available at the time of the production. Multiple assumptions regarding fertility, mortality, immigration and non-permanent residents, emigration, and interprovincial migration are developed on the basis of past trends, but also on the basis of a large consultation with key stakeholders and partners such as the provincial and territorial statistical focal points, the Advisory Committee on Demographic Statistics and Studies and several federal departments. These assumptions are used to build multiple variant scenarios in order to reflect the uncertainty inherent to all projection exercises.

7. Statistics Canada recently expanded its consultation process by surveying the Canadian community of demographers about their opinion of future demographic trends. The impetus for this venture and the survey design were inspired in large part by recent examples from agencies such as the ONS, INSEE and IIASA. The inputs from the survey were used to estimate plausible targets for the main components of the growth and a variance around these targets in a consistent manner from one component to the next

8. Over the last ten years, Statistics Canada has also developed population projections using microsimulation for specific sub-groups of the population (immigrants, visible minority groups, religious denomination, mother tongue, education, labour force) and at sub-provincial geographical levels. Microsimulation techniques facilitate the inclusion of several variables beyond age and sex and the consideration of differentials in demographic behaviours between sub-groups of the population (composition effects). These more detailed projections are based on the latest census microdata file, but also draw on a large number of other data sources to compute numerous input parameters, including censuses, administrative data, surveys and record linkages. These projections are complementary to

the national projections, addressing external requests and internal needs (such as survey weighting).

9. Key stakeholders of Statistics Canada's population projections include federal, provincial and municipal departments and agencies, the private sector, think tanks, academics and researchers.

3. France

10. The Institut National de la Statististique et des Études Économiques (INSEE) produce sets of projections. The frequency is unclear but a 1 January 2005 based set were produced in 2006 and a 1 January 2007 based set were produced in 2010.

11. The projections relate to Metropolitan France and the latest set run until 2060.

12. In terms of sub-national projections they are made by INSEE on the basis of the results of the population census. They are made for the whole of a territory or for any area composed of several municipalities with a total of over 50,000 inhabitants (a department, a region, an urban area, major towns or any ad hoc territory).

13. It is not clear whether these sub-national projections are made consistent with the national projections.

4. Germany

14. The Federal Statistical Office produces national population projections periodically, previously every two years, although the latest set with the base of 31 Dec 2008 were produced in 2009 with further detail published in 2010. The NSI is currently integrating the results of the 2011 Census so projections are likely to be made again once that task is complete. The horizon for the latest set of projections is to 2060.

15. At the same time as projections are produced at the national level the projections are also produced at the Länder level. This is still a fairly high level geography. Projections are not easily found below Länder level – if they are produced it is likely that they are the responsibility of the statistical offices in each area.[30]

16. The projection assumptions are produced using a combination of trend analysis and expert opinion and judgement.

17. Similar to the UK, Germany produces plausible alternative assumptions which are used to produce alternative projection runs to indicate uncertainty to users. These only appear to be done at the national level.

5. Italy

18. L'Istituto nazionale di statistica periodically produces national population projections. The latest set has a base point of 1 January 2011. The projections are described as having three phases. They are aimed at the future demographic development of the country in the short, medium and long term. They advise that the long-term data should be treated with extreme caution.

6. Netherlands

19. The Dutch Centraal Bureau voor de Statistieik have a bi-annual cycle of producing population projections. These are produced for even numbered base years. For odd

[30] See for example https://www.statistik.bayern.de/statistik/byrbz/

numbered years - a 'Core Prognosis' on the future population is released (for the same period as the projections). The core prognosis is based on the most recent data on fertility, mortality and migration with less analysis and only one projection is produced. The latest publication -28 Jan 2014 release- is only in Dutch and is the Core Prognosis for the period 2013-2060:

20. There is a difference between the 2012 based long term projections and the 2013 based Core Prognosis, which came out lower than the long term projections, mainly because of a higher level of emigration than was assumed in the projections.

7. New Zealand

21. Statistics New Zealand, for the first time, applied a stochastic (probabilistic) approach to producing population projections for the latest, mid-2011 based set. They provided the following commentary "Stochastic population projections provide a means of quantifying demographic uncertainty, although it is important to note that the estimates of uncertainty are themselves uncertain. By modelling uncertainty in the projection assumptions and deriving simulations, estimates of probability and uncertainty are available for each projection result. No simulation is more likely, or more unlikely, than any other. However, the simulations provide a probability distribution which can be summarised using percentiles, with the 50th percentile equal to the median. For each assumption, the median is equivalent to the 'medium' assumption used in previous deterministic projections. Similarly, the median stochastic projection is equivalent to the deterministic projection that combined the medium fertility, medium mortality, and medium migration assumptions in previous projections (ie series 5 in the 2009-base projections)."

22. At the same time an update was produced to the sub-national projections. This was not done on a stochastic basis but there are plans to produce the next set of sub-national projections using the probabilistic approach.

8. Norway

23. Statistics Norway produces new sets of projections every two years. The cohort component method is used. Probabilities are used for all components including migration. The projections are made at national and sub-national level and are run at the national level to 2100 and the sub-national projections until 2040.

24. Their website has a helpful paragraph on the use of the projections which says "The most important users of Statistics Norway's population projections are public and private planning bodies at the municipal, county and central government levels, as well as journalists, researchers, politicians and the general public. Every year, there are more than 35,000 downloads of the population projections from SSB's StatBank Norway. The projections are also used internally in SSB, for example as input in macroeconomic models such as KVARTS, MODAG and MSG, and in the micro-simulation model MOSART."

9. Spain

25. The Instituto Nacional De Estatistica (INE) normally produces long-term national projections every three years.

26. Projections relate to the normally resident population of Spain. This includes all long-term international migrants.

27. Short-term projections at a sub-national level are produced for 10 years forwards. These are produced every year.

28. The projections are based on a now cast of the population at the 1st of January, the latest base being 1 January 2012.

29. Projections appear to be predominantly trend based, based on fairly short runs of historical data.

30. It does not appear as though any indications of uncertainty are produced alongside the projections.

10. United Kingdom

31. The Office for National Statistics (ONS) in the UK normally produces national population projections every 2 years on behalf of the National Statistician and the Registrars General of Scotland and Northern Ireland.

32. Projections relate to the usually resident population of the UK and its constituent countries, regardless of their nationality. The usually resident population includes all long-term international migrants (people changing their country of usual residence for at least one year). However, it does not include short-term migrants who come to the UK for less than a year.

33. The projections are based on the population estimates at a given base date and a set of underlying demographic assumptions regarding future fertility, mortality and migration. The assumptions are based on the best statistical evidence available at the time agreed in liaison with the devolved administrations – Welsh Government, National Records of Scotland (NRS) and Northern Ireland Statistics and Research Agency (NISRA) - following consultation with key users of projections in each country and advice from an expert academic advisory panel.

34. The primary purpose of the national population projections is to provide an estimate of the future population of the UK and its constituent countries which is used as a common framework for national planning in a number of different fields. They are also used as the base for other official population projections such as sub-national projections, household projections and in the calculation of life tables.

35. Due to the inherent uncertainty of demographic behaviour, any set of projections will inevitably prove incorrect, to a greater or lesser extent, as a forecast of future demographic events or population structure. To give users of the projections an indication of this uncertainty, a number of variant population projections are produced based on alternative assumptions of future levels of fertility, mortality and migration.

36. Projections below national level are the responsibility of each country within the United Kingdom. Thus ONS produce projections for England only, National Records Scotland (NRS), Welsh Government (WG) and the Northern Ireland Statistics and Research Agency (NISRA) produce projections for their own country. It is notable that while ONS, NRS and NISRA constrain the sub-national projections to the national projections Wales do not.

11. United States of America

37. The US Census Bureau Population Projections Program produces projections of the United States resident population by age, sex, race, and Hispanic origin. The 2012 National Projections are based on the July 1, 2011 population estimates, which are based on the 2010 Census, and provide projections of the population for July 1, 2012 to July 1, 2060. The projections were produced using a cohort-component method and are based on assumptions about future births, deaths, and net international migration. The Census Bureau releases new national projections periodically.

38. The 2012 National Projections include a main series and three alternative series. These four projections series provide results for differing assumptions of net international migration. The main series, referred to as the Middle series, was released in December

2012. The alternative series, released in May 2013, were based on assumptions of low, high, and constant levels of net international migration. All other methodology and assumptions, including fertility and mortality, are the same as those used in the Middle series. The three alternative series are useful for analyzing potential outcomes of different levels of net international migration.

39. The website also notes in the "About the statistics" page that Eurostat also produce projections for Norway. The "about the statistics" page is an excellent example to other NSIs of how to communicate about statistics.[31]

C. Web links

Country	Web links
Australia	http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/3222.0Main+Features12012%20(base)%20to%202101?OpenDocument
Canada	Population Projections for Canada, Provinces and Territories http://www.statcan.gc.ca/pub/91-520-x/91-520-x2010001-eng.htm Projections of the Diversity of the Canadian Population, 2006 to 2031 http://www.statcan.gc.ca/pub/91-551-x/91-551-x2010001-eng.htm Population Projections by Aboriginal Identity in Canada (91-552-X) http://www.statcan.gc.ca/pub/91-552-x/91-552-x2011001-eng.htm Projected trends to 2031 for the Canadian labour force http://wwwstaging.statcan.gc.ca/pub/11-010-x/2011008/part-partie3-eng.htm
France	http://www.insee.fr/fr/publications-et-services/default.asp?page=dossiers_web/projections-population/projections-population.htm
Germany	https://www.destatis.de/EN/FactsFigures/SocietyState/Population/PopulationProjection/PopulationProjection.html
Italy	http://demo.istat.it/uniprev2011/note.html
Netherlands	http://www.cbs.nl/NR/rdonlyres/5631920F-F0CA-4D33-8B0C-28CB79EC9AAB/0/20140102b15art.pdf (latest publication - in Dutch)
New Zealand	National http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalPopulationProjections_HOTP2011.aspx Sub-national http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/SubnationalPopulationProjections_HOTP0631UpdateOct12.aspx
Norway	http://www.ssb.no/en/befolkning/statistikker/folkfram/aar/2014-06-17#content
Spain	Long-term national projections http://www.ine.es/jaxi/menu.do?type=pcaxis&path=%2Ft20%2Fp251&file=inebase&L=1 Short-term sub-national projections http://www.ine.es/jaxi/menu.do?type=pcaxis&path=%2Ft20%2Fp269&file=inebase&L=1

[31] http://www.ssb.no/en/befolkning/statistikker/folkfram/aar/2014-06-17?fane=om#content

United Kingdom	National http://www.ons.gov.uk/ons/rel/npp/national-population-projections/2012-based-projections/index.html Sub-national England http://www.ons.gov.uk/ons/rel/snpp/sub-national-population-projections/2012-based-projections/index.html Wales http://wales.gov.uk/statistics-and-research/local-authority-population-projections/?lang=en Scotland http://www.gro-scotland.gov.uk/statistics/theme/population/projections/sub-national/ Northern Ireland http://www.nisra.gov.uk/demography/default.asp47.htm
USA	http://www.census.gov/population/projections/data/national/2012.html

United Nations ECE/CES/2015/9

Economic and Social Council

Distr.: General
25 March 2015

Original: English

Economic Commission for Europe

Conference of European Statisticians

Sixty-third plenary session
Geneva, 15-17 June 2015
Item 6 (a) of the provisional agenda
Outcomes of the in-depth reviews carried out by the Conference of European Statisticians Bureau

In-depth review of measuring extreme events and disasters

Prepared by the National Institute of Statistics and Geography (INEGI) of Mexico

Summary

The present note is the in-depth review paper on measuring extreme events and disasters. The Bureau of the Conference of European Statisticians conducted the in-depth review at its meeting in October 2014. The purpose of the reviews is to improve coordination of statistical activities in the region of the United Nations Economic Commission for Europe, identify gaps or duplication of work, and address emerging issues.

The note summarises international statistical activities related to measuring extreme events and disasters, identifies issues and challenges, and makes recommendations how the international statistical community could tackle the issues.

The outcome of the review is provided in document ECE/CES/2015/9/Add.1.

GE.15-06436 (E)

1506436

Please recycle

I. Executive summary

1. Disasters are caused by natural phenomena or human action triggering processes that cause physical and environmental damage, loss of human lives and capital. These disasters may be natural or man-made, ranging from earthquakes, floods and tsunamis to extreme temperatures, forest fires and other natural phenomena. Disasters impact communities and individuals, as well as the economic activity of the affected territories. Recovery from such events requires government action. In many countries this would be impossible without external resources.

2. Whenever a disaster strikes, statistical offices are one of the sources asked to quickly provide data on the population, areas and businesses affected. This in-depth review presents a summary of the activities of several national and international statistical organizations for measuring extreme events and disasters.

3. The paper outlines the main actions and challenges entailed in this area. Over the past three decades, the frequency of natural disasters has increased worldwide, especially in certain regions such as Asia and the Pacific. Additionally, risk exposure has increased with the growth of unplanned urbanization and concentration of people and economic activities in disaster-prone areas.

4. Different statistical offices and international organizations are addressing these issues. Therefore, it would be useful to address this problem in a collaborative way with a common conceptual basis, instead of each organization searching and offering its own solution.

II. Introduction

5. The Bureau of the Conference of European Statisticians (CES) regularly reviews selected statistical areas in depth. The aim of the reviews is to improve coordination of statistical activities in the UNECE region, identify gaps or duplication of work, and address emerging issues. The review focuses on strategic issues and highlights concerns of statistical offices of both a conceptual and a coordinating nature. The current paper provides the basis for the review by summarising the international statistical activities in the selected area, identifying issues and problems, and making recommendations on possible follow-up actions.

6. The CES Bureau selected the topic of measuring extreme events and disasters for an in-depth review at its meeting in January 2014. The National Institute of Statistics and Geography (INEGI) of Mexico volunteered to prepare the paper providing the main basis for the review.

7. Climate change and disaster risk reduction and their effects are one of the areas of focus of the UN Open Working Group discussing the post-2015 development agenda. A world conference on extreme events and disasters was held in March 2015.

III. Scope/definition of the statistical area covered

8. A disaster can be defined as "a situation or event which overwhelms local capacity, necessitating a request for external assistance at national or international level; an unforeseen and often sudden event that causes great damage, destruction and human suffering". This definition is used by the World Health Organization collaborating Centre for Research on the Epidemiology of Disasters (CRED) that provides a worldwide database on disasters with a number of statistics.

9. Measuring the environmental, social and economic impact of disasters is important for decision-making related to prevention and preparation to deal with these events. The coordinated delivery of good quality data helps to define the type of actions to be taken for an effective recovery of the affected areas. The key data needs relate to statistics on the environment, climate change and sustainable development. Access to geographic information is a necessity. To date, it has not yet been exactly defined which statistics would be needed most for the measurement of extreme events and disasters, their causes, impacts and for preparedness and recovery efforts.

10. All nations are exposed, to a greater or lesser extent, to extreme natural events. However, these natural events do not always cause a disaster. To improve preparedness to facing a natural event the conditions of vulnerability need to be considered. The potentially destructive natural phenomena over a territory are identified as threats.

A. Types of disasters

11. Disasters arise from a complex relationship of effects generated by natural phenomena with preconditions of social, economic and environmental vulnerability. They are usually classified according to the characteristics of the natural threat that originated them, the type of phenomenon, the way it appears (sudden, such as earthquakes, or mediate, such as hurricanes), and its duration (short, medium or long-term). One of the most commonly used classifications is contained in the United Nations International Strategy for Disaster Reduction (UNISDR), which classifies disasters in four categories according to their origin:

(a) Earth's internal dynamics, geophysical phenomena;

(b) Earth's external dynamics;

(c) Meteorological and hydrological;

(d) Biological.

Table 1
Disaster classification, according to the type of phenomenon that it is caused by

1.- Disaster generated by dynamic processes inside the earth: a) Earthquakes - Crustal movements that generate intense deformation in rocks inside the earth, the accumulated energy is suddenly released in waves that shake the earth's surface. b) Tsunamis - Crustal movements that originate in the ocean, forming and propagating high waves. c) Volcanic Eruptions - Pass of material (magma), ash and gases from within the earth to the surface. **2.- Disasters caused by dynamic processes in the surface of the earth:** a) Landslides - Occur as a result of sudden or gradual changes in the composition, structure, hydrology or vegetation of a slope or sloping ground b) Collapse - Drop of a strip of land that loses stability or destruction of a man-built	**3.- Disasters caused by meteorological and hydrological phenomena:** a) Flooding - Slow or violent flooding of water from rivers, ponds or lakes, due to heavy rainfall or dam breaks, causing considerable damage. They can occur slowly or gradually over plains and violently or suddenly in mountainous regions. b) Droughts - Deficiency of moisture in the atmosphere due to irregular or insufficient rainfall, or inappropriate use of groundwater, reservoirs and irrigation systems. c) Frost - Atmospheric phenomena produced by low temperatures that cause damage to plants and animals. d) Thunderstorms - Atmospheric phenomena produced by electrical discharges in the atmosphere. e) Hailstorm – A form of solid precipitation (rainwater forming into ice).

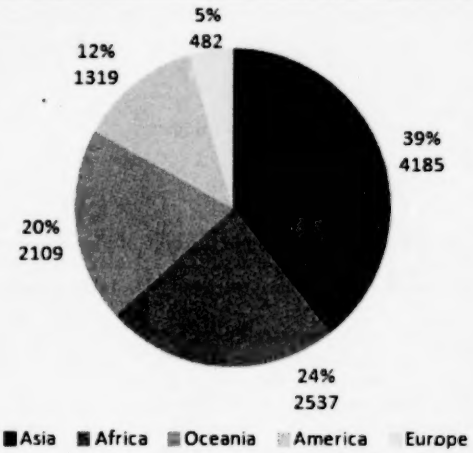
structure. c) Snowslides – Movement of mass of snow downhill. d) Floods - Flow of large volumes of mud, water, ice or rocks caused by the rupture of a water body or sliding snowy mass. e) Huaicos - Detachment of mud and rocks due to rainfall (presented as a stroke of muddy water sliding at high speed and low dry ravines flow, dragging rocks and logs).	f) Tornadoes - Hurricane winds rotating at high speed. g) Hurricanes - Winds in excess of 24 km / h as a result of the interaction of warm, moist air from the Pacific Ocean with the cold air. **4.- Disaster of biological origin:** a) Pest - Calamities to crops caused by certain types of insects. b) Epidemic - a widespread occurrence of an infectious disease to a large number of people in a particular place.

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on: United Nations Terminology on Disaster Risk Reduction, Geneva, International Strategy for Disaster Reduction, 2009 (online) http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf

12. Most of the disasters studied by the Economic Commission for Latin America and the Caribbean (ECLAC) are of climate - meteorological and hydrological - or geophysical origin. Between 1972 and 2011 these disasters were responsible for 309,742 deaths, affecting about 30 million people. They caused a total economic impact of approximately 213,000 million dollars, of which 150,000 million are damages and 63,000 million are losses. The following chart summarizes the disasters in the world.

Figure 1

Distribution of disasters in the world, according to the affected region, 1970-2011



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from the Center for Research on the Epidemiology of Disasters (CRED) / Attendance Office for Foreign Disaster Assistance (OFDA), International Database on disasters (EM-DAT)

13. The Latin American and Caribbean region is highly exposed to meteorological and hydrological phenomena. All areas of the continent are exposed to geophysical phenomena - earthquakes and volcanic eruptions. The following table shows the disasters, by region of the Americas and the type of event that caused them.

Table 2
America: disasters, by region and type of originating event. 1970-2011 (percentages)

Threat		North America	Central America	Mexico	Caribbean	South America
Geophysical	Earthquakes	3,4	11,5	12,2	2,4	9,8
	Mass movements	0,5	4,4	5,1	1,2	13,4
	Volcanic eruptions	0,3	5,2	4,1	2,0	3,7
	Total	4,3	21,0	21,3	5,6	26,9
Meteorological and hydrological	Hurricanes and storms	64,6	23,0	38,1	57,9	8,1
	Floods	24,5	38,3	27,9	27,6	45,9
	Droughts	1,6	7,1	3,6	4,9	5,7
	Extreme temperatures	3,7	1,4	7,6	0,0	5,0
	Total	94,4	69,7	77,2	90,5	64,8
Biological	Epidemics and plagues	1,4	9,3	1,5	3,9	8,4
	Total	100,0	100,0	100,0	100,0	100,0

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from the Center for Research on the Epidemiology of Disasters (CRED) / Attendance Office for Foreign Disaster Assistance (OFDA), International Data Base Disaster (EM-DAT)

14. These events need to be addressed with a systematic approach to develop capacities for prevention, adaptation and recovery.

15. In Mexico, the prevention strategy establishes three basic steps. *First*, know the dangers and threats that the territory is exposed to. *Second*, identify and establish characteristics and current risk levels at national, state, municipal and community levels. *Finally*, design actions and programs to mitigate and reduce the risks before the occurrence of phenomena, by strengthening and upgrading the infrastructure on the one hand and the training of population to know what to do before, during and after an emergency on the other hand.

IV. Overview of international statistical activities in the area

A. United Nations organisations

1. Economic and Social Commission for Asia and the Pacific (ESCAP)

16. The Economic and Social Commission for Asia and the Pacific (ESCAP) at its 70th session in 2014 adopted a resolution to establish an expert group comprising statisticians and disaster management experts to work towards developing a basic range of disaster-related statistics.[1]

17. The first meeting of the expert group took place from 27-29 October 2014 in Sendai, Japan, where the group discussed development of a proposed framework for collection and dissemination of the basic range of disaster-related statistics,

[1] http://www.unescap.org/sites/default/files/E70_RES21_.pdf

including definitions, standards, and classifications. The framework will help member States in Asia and the Pacific to produce quality statistics on disasters that adhere to agreed standards to support policy decisions for disaster risk reduction and climate change adaptation.

18. The ESCAP data center[2] compiles statistics pertaining to development issues in the region from data series published by international organizations. It contains statistics on disasters from the Emergency Events Database (EM-DAT) including

- Number of natural disaster events;
- Mortalities from natural disasters;
- People affected by natural disasters; and
- Economic damages from natural disasters.

19. The definitions and methodological criteria used in various international disaster databases are not consistent with those currently used for official statistics by countries in the region, which leads to inconsistencies between statistics reported by different databases and measurements produced by official agencies within the member States. These inconsistencies and the general lack of agreed standards for disaster-related statistics in the region are a major hindrance for effective monitoring of the risks and resilience to disasters for ESCAP member States.

20. As an initial step to investigate these issues further, ESCAP, in collaboration with the UNDP Asia-Pacific Regional Centre, has conducted studies in five countries (Indonesia, Kiribati, Mongolia, Republic of Korea, and Sri Lanka) to understand current practices and coordination between National Statistical Offices (NSOs) and National Disaster Management Agencies (NDMAs) for the production of statistics on disasters. One of the key findings suggests that strong coordination between NSOs and NDMAs helps to improve the quality of statistics on disasters and associated analysis. A full summary of the findings will be presented in the first meeting of the expert group.

2. Economic Commission for Latin America and the Caribbean (ECLAC)

21. ECLAC has developed information systems related to economic, social and environmental development of Latin America and the Caribbean. These include the CEPALSTAT database that provides also information on natural disasters.[3]

22. In February 2014, ECLAC published the third edition of the *Handbook for Disaster Assessment*. The Handbook establishes procedures for the estimation of the effects and impacts of disasters within a consistent accounting logic. This allows separating the loss and additional costs, and systematizing the linkages between different sectors of the economy.[4]

3. Intergovernmental Panel on Climate Change (IPCC)

23. The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) jointly created the Intergovernmental Panel on Climate Change (IPCC) in 1988 to provide a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-

[2] http://www.unescap.org/stat/data/

[3] CEPALSTAT database:
http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=

[4] http://www.cepal.org/publicaciones/xml/9/52219/ManualparalaEvaluaciondeDesastres.pdf

economic impacts. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters. Since 1990, the IPCC has produced several assessment reports, special reports, white papers, methodologies and other key documents as official reference for policy makers and scientists.

24. A special report on managing the risks of extreme events and disasters was published in 2012[5] to advance climate change adaptation. It contains a Summary for Policymakers and nine chapters focusing on the relationship between climate change and extreme weather events, impacts of such phenomena and strategies to manage related risks and facilitate decision making. Chapter 1 describes the question of weather and climate extremes to understand and manage the risks; Chapter 2 discusses the determinants of exposure and vulnerability and concludes that each disaster has social and physical dimensions; Chapter 4 evaluates the observed and projected impacts, taking into account the characteristics by sector and by region; and Chapter 8 evaluates the interactions between sustainable development, reducing vulnerability and disaster risk.

4. Office for the Coordination of Humanitarian Affairs (OCHA)

25. OCHA is the part of the United Nations Secretariat responsible for bringing together humanitarian actors to ensure coherent response to emergencies. Its mission is to mobilize and coordinate effective humanitarian action in partnership with national and international actors in order to alleviate human suffering in disasters and emergencies.[6]

26. When an emergency occurs, OCHA's information management officers immediately start working with key partners to produce standard information products to support coordination of all the humanitarian organizations and the response operation. These include the Who What Where (3W) database, contact lists and meeting schedules. Tools such as the information need assessment and maps are made available to support better relief planning and action.

27. A clear information management structure ensures that all the organizations involved work with the same or complementary information, and that this information is as relevant, accurate and timely as possible. The data collected and analyzed is used as a foundation for situation reporting and for crafting public information messages. Properly collected and managed information during the emergency phase can benefit early recovery and disaster preparedness activities later.[7]

28. OCHA publishes annually "The World Humanitarian Data and Trends" that presents global and country-level data and trends analysis on humanitarian crises and assistance, including on natural disasters.[8] OCHA also produces an array of reports and publications from in-depth analytical papers to daily situation reports on major new crises and annual appeals for humanitarian funding.[9]

---

[5] https://www.ipcc.ch/pdf/special-reports/srex/IPCC_SREX_ES_web.pdf
[6] http://www.unocha.org/about-us/who-we-are
[7] http://www.unocha.org/what-we-do/information-management/overview
[8] http://www.unocha.org/what-we-do/policy/resources/world-humanitarian-data-and-trends-2013
[9] http://www.unocha.org/about-us/publications

5. United Nations Fund for Population Activities (UNFPA)

29. The report entitled "UNFPA State of World Population 2007" in chapter 5, Urbanization and Sustainability in the 21st Century[10], provides an analysis of some extreme events and disasters such as:

- Land cover changes;
- Cities and climate change;
- Poverty and vulnerability to natural disasters;
- Sea level rise: not if but when and how much?
- Adapting to climate change;
- Local actions, global consequences: global change, local impact.

30. UNFPA has developed the Demographic Explorer for Climate Adaptation (DECA) for Indonesia and Malawi, which can incorporate various data, particularly census data and other social survey data, into planning for climate change adaptation though spatial analytics.[11] It is an innovative free online tool for automated integration and analysis of multiple kinds of spatial data for knowledge in social, environmental and science policy by involving stakeholders in the spatial analysis and decision-making process.

6. United Nations Institute for Training and Research (UNITAR)

31. The UNITAR work related to extreme events and disasters aims to make satellite solutions and geographic information easily accessible to the UN family and to experts worldwide who work at reducing the impact of crises and disasters and help nations plan for sustainable development.[12]

32. Since early 2013, the Operational Satellite Applications Programme (UNOSAT) of UNITAR focuses on the use of Geographic Information Systems (GIS) and Remote Sensing (RS) to improve planning, emergency preparedness and risk prevention in vulnerable communities, mainly in Africa. This initiative is called GEODRR (Geographic Information Systems and Earth Observation for Disaster Risk Reduction[13]. The project's main objectives are to:

- Strengthen technical knowledge and skills in the use of GIS and RS technologies to enhance planning.
- Improve emergency preparedness and prevention across the region.
- Raise awareness on geospatial technologies for Disaster Risk Reduction and how to use this information for coordination, dissemination and decision making in the region.
- Improve service delivery and data delivery by developing an accessible, open source geo-portal.

---

[10] http://www.unfpa.org/swp/2007/spanish/chapter_5/poverty.html

[11] http://nijel.org/un_popclimate/blog/item/30-demographic-explorer-for-climate-adaptation-deca%E2%80%93an-automated-spatial-analysis-tool

[12] UNITAR. (s.f.). UNOSAT. http://www.unitar.org/unosat/who-we-are

[13] GEODRR. (s.f.). Building Capacities for Disaster Risk Reduction Using Geospatial Technologies in the Horn of Africa. http://www.geodrr.org/project.php?pId=7

7. United Nations International Strategy for Disaster Reduction (UNISDR)

33. UNISDR's mandate is to serve as the focal point in the United Nations system for the coordination of disaster reduction and to ensure synergies among disaster reduction activities. It reflects a major shift from the traditional emphasis on disaster response to disaster reduction, and seeks to promote a "culture of prevention".[14]

34. UNISDR coordinates international efforts in Disaster Risk Reduction and guides, monitors and reports regularly on the progress of the implementation of the Hyogo Framework for Action. UNISDR organizes a biennial Global Platform on disaster risk reduction with leaders and decision makers to advance risk reduction policies and support the establishment of regional, national and thematic platforms.[15]

35. The Hyogo Framework for Action is the guiding document in strengthening and building international cooperation to ensure that the principle of disaster risk reduction be used as a foundation for sound national and international development agendas. Moreover, the regional platforms are multi-stakeholder forums that reflect the commitment of governments to improve coordination and implementation of disaster risk reduction activities while linking to international and national efforts.

36. UNISDR informs and connects people by providing practical services and tools such as the risk reduction website PreventionWeb, publications on good practices, country profiles and the Global Assessment Report which is a biennial global assessment of disaster risk reduction and comprehensive review and analysis of the natural hazards that affect humanity.[16]

8. United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER)

37. The UN-SPIDER was established in 2006 to "Ensure that all countries and international and regional organizations have the ability to develop and access all types of information obtained from space, in order to support the full disaster management cycle".[17]

38. The UN-SPIDER program serves as a gateway to the information obtained from space to support the activities carried out in the context of risk management and response to emergencies and disasters; acts as a bridge between communities involved in risk management and response and the space community in case of emergencies or disasters; and facilitates capacity building and institutional strengthening, in particular in developing countries.

9. United Nations Statistics Division (UNSD)

39. UNSD disseminates global environment statistics[18] on ten indicator themes compiled from a wide range of data sources. One of these themes is natural disasters, further classified into climatological, geophysical, hydrological and meteorological disasters. UNSD notes that these environment statistics are still in early stages of development in many countries, and data are often sparse.

---

[14] http://www.unisdr.org/who-we-are
[15] http://www.unisdr.org/we/coordinate
[16] http://www.unisdr.org/we/inform
[17] http://www.un-spider.org/es
[18] UNSD Environmental Indicators: http://unstats.un.org/unsd/environment/qindicators.htm

40. Furthermore, the Framework for the Development of Environment Statistics (FDES) provides a conceptual and statistical framework and an organizational structure to guide the collection of environment statistics.

41. One of the six components of FDES, Component 4, focuses on extreme events and disasters, promoting the generation of information on the occurrence of the different types of extreme events, and statistics on the impact of the disasters, including people affected and the assessment of economic loss.[19]

B. Other organizations

1. Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC)

42. CATHALAC is an autonomous international organization dedicated to promoting sustainable development through applied research and development, education, and technology transfer in the areas of integrated watershed management, climate change, environmental modeling and analysis, and risk management in Latin America and the Caribbean.[20]

43. CATHALAC contributes to the SERVIR project, a regional visualization and monitoring system maintained in collaboration with the National Aeronautics and Space Administration (NASA), the United States Agency for International Development (USAID), the Central American Commission on Environment and Development, World Bank and Nature Conservancy. SERVIR integrates satellite and other geospatial data for research and decision-making by managers, researchers, students and the general public. It is available for Mesoamerica, East Africa and Himalaya, and covers nine areas under the Global Earth Observation System of Systems: disasters, ecosystems, biodiversity, weather, climate, water, health, agriculture and energy. SERVIR can be used to monitor and forecast ecological changes and significant events for forest fires, red tides, and tropical storms.[21]

44. The SERVIR team at CATHALAC has developed a geo-spatial portal which provides access to data and metadata from Mexico, Central America and the Caribbean. It maintains training programs and infrastructure to strengthen the use of earth observation and models for decision-making among government officials, scientists and researchers, NGOs, and academic institutions.

2. World Bank

45. During the past 10 years, the World Bank has emerged as a world leader in disaster risk management thanks to its support to client countries in the assessment of hazards and ways to address them. It provides technical and financial assistance in the assessment and risk reduction, preparedness, financial protection and recovery, and reconstruction resilient to these phenomena. The portfolio of disaster risk management maintained by the World Bank has grown about 20% annually in

---

[19] http://unstats.un.org/unsd/environment/FDES/FDES%20Flyer%20Spanish_7August2013_WEB.pdf

[20] http://cathalac.org/

[21] http://www.servir.net/sobre-servir.html

the past four years; reaching nearly $ 4,000 million in fiscal year 2013. The World Bank promotes a comprehensive and multisectoral approach in this area.[22]

46. The Global Facility for Disaster Reduction and Recovery (GFDRR) is the World Bank's institutional mechanism for disaster risk management. It is an alliance of 41 countries and eight international organizations with a growing number of participants. In February 2014 a World-Bank GFDRR Center in Tokyo was created with the support of Japan with a new program of $ 100 million. This will help to associate relevant expertise with customers and World Bank operations related to this field. The Earthquakes and Megacities Initiative is a related international scientific initiative and a member of the UN Global Platform for Disaster Risk Reduction and partner of the GFDRR. Its mission is to advance urban risk reduction policy, knowledge, and practice in megacities and fast-growing metropolises.[23]

47. Through the World Bank, the Code for Resilience initiative is promoted, which brings together technologists with mentors and experts to create technology-based tools that help communities to reduce disaster risk. The emerging applications range from support to rescuers in an emergency to the tool for digitizing data on maternal health.[24] The World Bank provides a Climate Change Knowledge Portal which provides possibilities to query, map, compare, chart and summarize key information on climate-related vulnerabilities and impacts. The Portal contains spatially referenced environmental, disaster risk, and socio-economic datasets, and country-level disaster statistics and maps displaying sub-national risk data for natural hazards, such as cyclones, droughts, earthquakes, volcanoes, floods, and landslides. In the coming months, the Climate Change Knowledge Portal will include access to Open Data for Resilience Initiative, which aims to reduce the impacts of disasters by empowering decisions-makers with better information and tools.[25]

3. World Health Organisation collaborating Centre for Research on the Epidemiology of Disasters (CRED)

48. CRED has been active for more than 35 years in the field of international disaster and conflict health studies, with research and training activities linking relief, rehabilitation and development. The Centre promotes research and provides a database on the burden of disease and related health issues due to disasters and conflicts.

49. CRED has a long history of standarized data compilation, validation and analysis. It provides free and open access to its data through its website. One of CRED's core data products is the International Emergency Disasters Database (EM-DAT)[26] that contains worldwide data on the occurrence and impacts of more than 19500 disasters in the world dating from 1900 to the present. EM-DAT is compiled from various sources, including UN agencies, non-governmental agencies, insurance companies, research institutes and news agencies. This database is free and fully searchable through the website, also allowing users to download available data.[27]

---

[22] http://www.bancomundial.org/es/topic/disasterriskmanagement/overview#2
[23] http://www.emi-megacities.org/home/
[24] http://www.bancomundial.org/es/news/feature/2014/06/30/innovative-apps-for-disaster-risk-reduction-win-global-attention
[25] http://sdwebx.worldbank.org/climateportal/index.cfm
[26] EM-DAT database: http://datahub.io/fi/dataset/emdat
[27] http://www.cred.be/projects

50. For a disaster event to be registered in the EM-DAT database, at least one of the following criteria must be met:[28]

- Ten (10) or more people reported dead.
- One hundred (100) or more people reported affected.
- Declaration of state of emergency.
- Call for national or international assistance.

Note: These criteria are not consistent with the definitions used in official statistics of countries, causing inconsistencies between sources.

51. CRED notes in their Annual Disaster Statistical Review 2012 that development of guidelines and tools for creating national and sub-national disaster databases and compiling reliable, standardized, interoperable disaster occurrence and impact data should be prioritised for more effective disaster risk reduction.[29]

V. Country practices

A. Involvement of statistical offices

52. There are a number of national disaster databases, although national statistical systems rarely collect data on disasters. In some cases national statistical offices are involved in such databases, usually as provides of economic, social and environmental statistics that will be linked with information on extreme events and disasters in the database.

53. National disaster databases include for instance the Emergency Management Australia Disasters Database, the Canadian Disaster Database, the Indian disaster statistics database, the Spatial Hazard Event and Losses Database for the United States, the United States Storm and Hazard Database, the United States National Hazard Statistics, the Philippines Disaster Response Operations Monitoring and Information Center, and the Philippines National Disaster Coordinating Council database.

54. Often the primary sources for disaster databases appear to be research institutions and the media but also government agencies, local emergency management organizations, municipal governments, insurance companies and non-governmental organizations. According to available information at least in Australia, the statistical authorities provide statistical data to the national disaster database. This includes data on the number of people killed, injured and otherwise affected. In India and Philippines the statistical authorities have an active role also in developing the national disaster databases.

55. For instance, the Indian statistical office, in collaboration with the National Disaster Management Institute, has developed a disaster statistics database. Due to the geography and topography, India has faced serious large scale natural disasters like droughts, cyclones and earthquakes, and the number of disasters and people affected has been rising.

[28] Session 4: Extreme Events and Disasters. http://www.unescap.org/resources/session-4-extreme-events-and-disasters FDES-Component 4 (Core set) Extreme Events and Disasters_ESCAP_SD

[29] http://reliefweb.int/sites/reliefweb.int/files/resources/ADSR_2012.pdf

56. These two organizations in India are developing a framework for compilation of hazards and disaster statistics to be released on regular basis in the form of an annual publication. The database includes information on the impacts of climate change and other disasters such as droughts, floods, landslides, extreme variations of temperatures etc. The disaster statistics contain three parts: damage, relief and reconstruction.

57. This project has shown that there is a need for coordination among agencies and institutionalization of the process for learning from experiences obtained from disasters. Data has an important role in promoting a culture of prevention, mitigation, preparedness and response.

B. Measurement of extreme events and disasters in Mexico

58. Mexico is exposed to a great variety of phenomena that may cause disasters, in part because of its geographic position. It is located in the Ring of Fire or Circum-Pacific belt, and is subject to earthquakes and eruptions of volcanoes. Two thirds of the country have an important seismic risk because of the Pacific Ocean coast where the tectonic Cocos and the North American plates meet. There are also many volcanoes of which fourteen are considered as active.

59. The country is located in the intertropical region and is regularly in the path of hurricanes from the Pacific Ocean, the Gulf of Mexico and the Caribbean Sea. The effects from hurricanes are felt mainly in the coastal zones. Four or five hurricanes out of the average 23 which approach the country each year cause landfalls and severe damage.

60. Rain scarcity is common in several regions in the country. When maintained during long periods, the drought affects agriculture, livestock and the economy in general. Forest fires are also frequent during the dry season and scarce rainfall. In some years there are particularly numerous forest fires causing severe forest losses and other damages.

61. Other types of disasters are caused directly by human activities, mainly from industrial accidents involving hazardous materials.

1. Hydrometeorological phenomena

62. From 2000 to 2011, about 90% of the disasters in Mexico were hydrometeorological. Between May and November there is an average of 23 hurricanes; 14 in the Pacific Ocean and 9 in the Gulf of Mexico and the Caribbean Sea. Four of these cause landfall.

63. Based in the regions where the hurricanes enter the country, the states of Baja California Sur, Michoacan, Sinaloa, Sonora and Tamaulipas have the largest hurricane frequency affecting 40% of the total population in those states. In the states of Campeche, Colima, Quintana Roo and Jalisco, the hurricanes occur about every five and seven years. About 26.3 per cent of the population is located in the coastal zones in these states. Finally, in the states of Nayarit, Guerrero, Tabasco Tamaulipas, Oaxaca, Veracruz, Chiapas and Yucatan, the recurrence time is between eight and 26 years, with 23.9 per cent of the population exposed.

64. Droughts are an incidental or sporadic phenomena that cause a disaster. They occur in areas with moderate rainfall when there is no rain for long periods. In the case of Mexico, in 2011 the National Peasant Confederation estimated that 450,000 cattle were lost during the drought in the northern states of the country. Other effects of this phenomenon include: lack of potable water, exodus of people from rural areas; weight loss of cattle as there are no pastures, and vulnerability to epidemics.

2. Geologic phenomena

65. Among geologic disasters, landslides have the biggest impact. Among the main causes of landslides are instability because of morphological factors, geologic materials, high slopes and high rainfall, as well as deforestation. A partial list of landslides in the past years is presented in the following table.

Table 3
List of some landslides registered between 1999 and 2013

Date	Type of landslide	State	Municipality	Town/City	Deaths
16 Sep 2013	Detritus flow	Guerrero	Atoyac de Alvarez	La Pintada	71
06 Feb 2010	Detritus flow	Mexico	Temascaltepec	Temascaltepec	10
03 Feb 2010	Detritus flow	Michoacan	Mineral de Angangueo	Mineral de Angangueo	35
28 Sep 2010	Detritus flow	Oaxaca	Santa Maria Tlahuitoltepec	Santa Maria Tlahuitoltepec	11
05 Nov 2007	Combined landslide	Chiapas	Ostuacan	Juan de Grijalva	30
03 Jul 2007	Translational landslide	Puebla	San Miguel Eloxochitlan	San Miguel Eloxochitlan	60
04 Oct 2005	Mudflow	Chiapas	Mapastepec	Valdivia	15
04 Oct 2004	Detritus flow	Chiapas	Motozintla	Motozintla	11
05 Oct 1999	Landslide	Puebla	Teziutlan	Col. La Aurora, Teziutlan	70

Source: CENAPRED-2001- Diagnosis of hazards and disaster risk identification in Mexico

3. Chemical phenomena

66. Chemically related accidents may be caused by natural phenomena, flaws in industrial processes, mechanical failures and unintentional or intentional human errors. Some of the substances with pose the greatest risk in Mexico according to the hazard level of chemical substances, their geographic distribution and stored amounts, are: liquefied petroleum gas (LPG), ammonia, sulfuric acid, chloride, gasoline, nitrogen, propyl and isopropyl alcohol.

67. In 2011, chemical disasters caused 60 deaths and economic losses of $1.376 billion Mexican pesos. That is about 3% of all the economic losses caused by disasters that year. However, damages have increased in the last years, mainly because of forest fires, as shown in the following table.

Table 4
Summary of damages by chemical disasters in 2011

Type	*Temporal shelters*	*Deaths*	*Population affected* *	*Population with damages*	*Households*	*Schools*	*Hospitals and other health facilities*	*Cropland or pasture (hectares)*	*Businesses*	*Total damage (million pesos)*
Forest fires	0	0	944	0	0	0	0	956,404.8	0	1,366.1
Fires in urban zones	1	4	8,440	142	30	4	0	0.0	280	5.5
Explosions	1	52	1,541	268	115	1	1	0.0	25	2.9
Spills	0	0	651	50	10	0	0	0.0	1	1.6
Leakages	1	4	10,481	0	0	0	0	0.0	2	0.0
Total	**3**	**60**	**22,057**	**460**	**155**	**5**	**1**	**956,404.81**	**308**	**1,376.1**

* It includes injured, evacuated and/or missing persons. Source: CENAPRED, with data from CENACOM and CONAFOR.

4. Other types of disasters

68. Other disasters are caused by human error or intentional actions involving a high number of people.

Table 5
List of disasters caused by human error or intentional actions

Date	*Disaster*	*State*	*Municipality*	*Deaths*
17 Apr 2006	Transport accident	Veracruz	Maltrata	57
05 Jun 2009	Urban fire	Sonora	Hermosillo	49
06 Aug 2002	Transport accident	Michoacán	Zinapécuaro	32
09 Sep 2007	Transport accident	Coahulia	Sacramento	29
19 Mar 2002	Transport accident	Jalisco	Mascota	27
06 May 2006	Transport accident	San Luis Potosí	Cerritos	26
24 Jan 2007	Transport accident	Oaxaca	Huautla	26
15 Feb 2006	Transport accident	Guanajuato	Sta. Catarina	25
28 Dec 2006	Transport accident	México	Cuautitlán	22
05 Nov 2010	Transport accident	Sinaloa	Escuinapa	21
05 Apr 2005	Transport accident	Baja California Sur	Comondú	21
19 May 2008	Transport accident	Hidalgo	Metzquititlán	21

Source: Economic and Social Studies Office, with data from the National Communication Center.

Table 6
Summary of impacts from accidents and disasters in 2011

Disaster/ accident type	Deaths	Population affected (persons) [1/]	Damaged households	Damaged schools	Health care units	Cropland /pasture (hectares.)	Damaged roads (km)	Total economic losses (in million Mexican pesos)
Geological	16	35,874	1,217	11	9	0.0	1.0	416.6
Hydro-meteorological	164	1,717,533	49,410	3,882	90	1,540,861.6	19,359.5	39,543.8
Chemical [2/]	60	22,057	155	5	1	956,404.8	0.0	1,376.1
Health	1	62	0	0	0	0.0	0.0	0.0
Social	186	3,267	2	1	0	0.0	0.0	74.5
Total	427	1,778,793	50,784	3,899	100	19,390.5	19,360.5	41,411.0

[1/] Includes persons injured, evacuated or with some other kind of damage.
[2/] Chemical disasters: leakages, spills forest and urban fires, explosions.
Source: CENAPRED.

5. Work on data related to disasters in Mexico

69. Statistics on the occurrence and effects of disasters in Mexico are generated primarily from the records of the Coordination of Civil Protection under the Ministry of Interior. These data are supplemented with information from INEGI, the National Weather Service, the National Seismological Service and various civil society organizations.

70. The gaps in data for Mexico can be estimated based on the Framework for the Development of Environment Statistics (FDES). The component 4 "Extreme Events and Disasters" describes 33 statistics that can be generated on this topic. The main information gaps are in the estimation of economic losses, in the occurrence of technological disasters and the effects of disasters on the ecosystem integrity.

71. INEGI coordinates the project "Development and Strengthening of Official Environmental Statistics through the Creation of a Regional Framework in Latin America and the Caribbean" with support from the Inter–American Development Bank. The main objective of the project is to promote a collective effort to strengthen the official environmental statistical system in the countries involved. The project has the following goals:

(a) Analyze the present state of environmental statistics and develop and improve the quality of these statistics;

(b) Promote coordination among the institutions related to environmental statistics, indicators and accounting at the national level;

(c) Strengthen cooperation among countries in the region to promote standardization and compatibility of environmental statistics.

72. As part of the actions related to disasters, the INEGI Governing Board will designate a Specialized Technical Committee of Information on the National Civil Protection Subsystem and Environment. The Committee will promote the coordination between the three levels of government to strengthen the preventive actions, reduce risks and mitigate the consequences of extreme events and disasters. The Committee will be chaired by the Government Secretary of the National

Coordination of Civil Protection. It will be responsible for ensuring that statistical and geographical information on environment will be generated to:

(a) Identify natural phenomena and effects that are of interest for early warning systems;

(b) Organize data and information on hazards, risks and vulnerabilities, relating to economic, social, and environmental aspects;

(c) Characterize the major risk factors and threat levels of each phenomenon, their probability of occurrence, and the vulnerability and exposure to the phenomena.

73. The federal government established the General Law on Climate Change, making provisions to address the adverse effects of climate change. The law also stipulates the development of Mexican official standards and creation of the National Climate Change System for effective coordination of the various levels of government and cooperation between the public, private and social sectors.[30]

74. Additionally, the sectoral fund CONACYT-SECTUR prepared a "Study of vulnerability and adaptation program to climate variability and climate change in ten strategic tourist destinations and the proposal of a early warning system for extreme weather events". The study analyses, among other things, the physical and social vulnerability to climate change.[31]

(a) The following indicators were calculated for physical vulnerability:

- Coastal vulnerability index
- Storm surge flooding indicator
- River flooding indicator

(b) The following indicators were calculated for social vulnerability:

- Governance
- Citizen perception
- Exposure
- Social cohesion
- Responsiveness of the health sector
- Social vulnerability

75. This study represented an interdepartmental effort to generate knowledge on the impacts of climate change on the tourism sector and in designing adaptation programs for the analyzed destinations, with implications at national, regional, state and municipal level. The impacts of climate change are most evident at the municipal level and actions should be implemented at this level.[32]

76. It is proposed to establish an official standard in Mexico for specifications for environmental protection and mitigation of climate change effects in the planning, design and construction of coastal resorts and housing developments. These requirements will concern the site selection, design, planning, construction,

[30] CENAPRED Diagnosis of Hazard and Disaster Risk Identification in Mexico.

[31] Characteristics and socioeconomic impacts of major disasters occurred in Mexico in 2011. 1st Edition October 2013. Mexican Secretariat of the Interior (SEGOB)

[32] http://www.atlasnacionalderiesgos.gob.mx/index.php/riesgos-socio-organizativo

operation and decommissioning, rehabilitation, remodeling and expansion of tourism infrastructure, as well as the recovery of beaches.[33]

77. One of the main challenges is to have high quality, relevant, accurate and timely information to contribute to national development, as established in Article 3 of the Law of the National System of Statistical and Geographical Information.

VI. Impact of crises on the statistical area

78. In the event of disasters, it is common that economic losses are devastating for developing countries. The report "Natural hazards, natural disasters", prepared with support from the World Bank/GFDRR, shows that the impact of disasters to Gross Domestic Product (GDP), is 20 times bigger in developing countries than in developed countries.[34]

79. The effects of disasters will keep growing and climate change will aggravate that trend. The World Bank report "Building resilience", referred to in the Warsaw Climate Change Conference 2013, concludes that economic losses caused by natural disasters have grown from US$50 billion dollars per year during the 1980-ies to almost US$200 billion dollars a year in the last ten years.

80. Because of its geographic location and climate characteristics, the Caribbean area is a clear example of the vulnerability to natural disasters. The impacts involve several areas including the economy. However, the high human, environmental and economic costs associated to these natural events are mainly the result of a high vulnerability aggravated by inadequate or insufficient economic development policies, including those related to infrastructure, services, risk management and environment. The following table shows the main types of natural disasters and their impact in Latin America and the Caribbean (2010).

Table 7

Main types of natural disasters and their impact in Latin America and the Caribbean (2010)

Disaster type	Total occurrences	Deaths	Affected population	Cost (Million USD)
TOTAL	**98**	**225,684**	**13,868,359**	**49,188**
Climate related	79	1,380	9,318,685	9,840
Epidemiological	13	1,211	334,740	565
Geophysical	6	223,093	4,214,934	38,783

Source: Economic and Social Disaster Assessment Unit, UNO - ECLAC (1972-2009).

81. When natural disasters occur, attention to the direct human cost is the primary focus. However, negative economic effects are also significant. In the short term, these cause temporary interruption of economic activities and the loss of

[33] http://www.colpos.mx/web11/pdf/Proteccion_Civil/Riesgos_quimicos_s.pdf
[34] http://www.bancomundial.org/es/topic/disasterriskmanagement/overview

capital goods and human resources. Disasters also have long term economic effects such as decrease of GDP and increased foreign debt and social inequality.

Table 8

Natural disasters by continent (1999-2014)

Continent	Number of disasters	Deaths	Persons affected	Persons injured	Homeless	Total affected	Economic losses (x 1000 USD)
Africa	1473	80346	254790097	35571	3378427	258204095	13437735
America	1443	294473	104589792	2464130	3681767	110735689	691456061
Asia	2450	776083	2819962968	1837204	32936154	2854736326	817127834
Europe	897	142206	17096442	37475	215095	17349012	211600581
Oceania	238	2095	1993765	5263	92542	2091570	55298408
Total	**6501**	**1295203**	**3198433064**	**4379643**	**40303985**	**3243116692**	**1788920619**

Source: Compilation of data by continent. The International Disaster Database (CRED / EM-DAT), Université Catholique de Louvain, Belgium http://www.emdat.be/

82. Based on the above, we can say that disaster risk management requires both knowledge of threats and vulnerabilities, and the systematic collection of data on damages and losses. The increasing number of disasters creates a growing need for statistical data. It is increasingly necessary to link the data from statistical offices and other agencies that provide various administrative records to determine the impact of disasters on people and businesses.

VII. Issues and challenges

83. The following issues and challenges can be identified in connection with the efforts to increase awareness about disasters and associated risks:

A. Issue 1 - Information to measure the impact of disasters

84. To formulate and estimate the financial requirements for the recovery and reconstruction it is essential to have quantitative information about the effects and impacts of the disasters and estimates of their economic cost. Monetary estimates of the damage and sectoral losses and the potential macroeconomic effects are needed. In addition, the diversity of scenarios of being affected by a disaster must be accounted for: the economic, spatial and demographic impact, the value of capital exposed to damage, the institutional development of countries and the size and resilience of the affected economies.

B. Issue 2- Lack of common classifications and definitions

85. There are no common classifications and agreed definitions of disasters and extreme events. Countries identify different types of disasters, some covering only natural disasters, others only man-made disasters and in some cases both. Measurements are often designed to serve specific policies. Therefore, it is necessary to have more comprehensive classifications to characterize different types of events and capture appropriately the differences between natural and socio-natural disasters. It should allow to reflect the cumulative effects that usually occur in bigger disasters or by the accumulation of consequences of past disasters.

C. Issue 3 - Measuring vulnerability

86. The vulnerability factors that recurrently contribute to the occurrence of disasters should be clearly identified: poverty, closely related to the level of economic development of countries; urban expansion to areas at high risk of floods and landslides; absence of building codes and lack of financial prevention measures; strong economic dependence on agricultural activities with high exposure to climatic variations and hurricanes; increasing degradation of the environment, both locally and globally, and the presence of large-scale processes, ranging from deforestation in certain areas to the climate change, causing the increase in sea level and major changes in regimes of rainfall worldwide.

D. Issue 4 – Vulnerability of cities to disasters

87. Cities are highly dependent on external inputs (energy, raw materials, food, etc.) and therefore highly vulnerable. Cities are not self-sufficient to ensure their reproductive cycles, and are therefore hard to sustain. In Risk Management analysis, the cities could be considered as a Socio-Artificial Ecosystem with functions that exceed its spatial limits. Thus, the study of urban vulnerability to disasters should be a guiding principle of a Risk Atlas and a normative benchmark for Plans and Programs for Urban Development.

E. Issue 5- Duplication and heterogeneity of information

88. The data on disasters and extreme events are compiled from various sources, including UN agencies, NGOs, insurance companies, research institutes and press agencies. Sometimes new data sets duplicate the available data in existing statistical systems. In addition there may be lack of adequate data, insufficient frequency of updates, inconsistency of information between different institutions, difficulty to access the information, differences in data quality depending on the variable in question and the geographical unit, and unclear and imprecise identification of government actions in different areas.

F. Issue 6 - Importance of national coordination

89. Coordination at national level is very important. In Mexico, the National System of Civil Protection (NSCP) is a set of structures, functional relationships, methods and procedures that include the departments and agencies of the public sector together with various social and private voluntary groups, and the state authorities at different levels. The system must operate in a coordinated way in the event of a disaster and in recovery efforts.

90. A forum is needed to provide socio-economic, geographical and environmental information allowing to monitor the change of the risk conditions for civil protection purposes (e.g. in Mexico a National Center for Disaster Prevention). Its task is to coordinate the updating of this information and conducting field operations to collect information, and allow to use public resources, such as remote sensing images, for the development of a risk atlas.

VIII. Conclusions and recommendations

91. A flexible and adaptable international classification of disasters is required to systematize information and statistics on disasters. One of the more often used classifications is the one by the United Nations International Strategy for Disaster Reduction (UNISDR).

92. The data from the population and housing census and sectorial censuses (agricultural and livestock, manufacturing and mines, inter alia) are of particular utility to acquire reliable and accurate information about the affected territory and its population. Statistical yearbooks and publications of statistical offices and census departments can be also used, as well as those prepared by national research centers, universities and recognized institutes. Information from national government, including on civil protection related issues, organizational capacity, regulatory provisions and equipment and infrastructure available for disaster relief are important to support the design, implementation, monitoring and evaluation of policies on public safety.

93. The availability of a whole range of base data are important for an extensive and well documented analysis of the impact of disasters: information on population, economy and geography, as well as on government programs. Good coordination among institutions is needed to collect and share data and build an efficient Geographic and Statistical Information System. In this context, the NSOs should work together with other agencies in charge of prevention and response to natural disasters in several ways:

(a) Making available relevant geographic and statistical data, such as detailed data on population, roads, hydrography, terrain, natural resources, land cover and soil;

(b) Mapping areas and/or places affected by disasters using aerial photographs or satellite images acquired after the occurrence of a disaster;

(c) Sharing and making data available through a Web data exchange site;

(d) Contributing to the discussion to define strategies and information infrastructure to support government actions for the prevention and response to natural disasters.

94. The use of geographical and georeferenced statistical data is needed to develop services, such as the Risk and Vulnerability Atlas. It allows determining the areas or regions affected and their topographic characteristics. In addition to delimiting the affected territory, information on the organization and general functioning of different sectors is needed. Having a national framework for geo-referenced statistical information is imperative for these purposes. This must be recognized by all levels of government.

95. An important supporting element is the National Geospatial Data Infrastructure (NGSDI) allowing collection, maintenance, analysis, presentation and dissemination of spatial data. These are vital in the complex processes of decision making, particularly in sustainable development. This is of particular interest in the regions that are exposed to natural hazards. Efforts must be undertaken to promote this kind of initiatives. A good example is the Proyecto Caribe initiative to promote the development of a NGSDI in member countries of Association of Caribbean States to strengthen production, integration, analysis and dissemination of geospatial information. The aim is to create a knowledge database to face the climate change in these countries and strengthen their resilience capacity.

96. The number of natural disasters and the severity of their impacts have increased in recent decades. This has significantly hampered the economic development and allocation of resources for relief and recovery.

97. The scenarios analysed on the possible consequences of climate change indicate that droughts will become more intense and hurricanes more frequent; agricultural areas will be displaced or modified, and the sea level will rise. This highlights the need to incorporate in spending and investment decisions issues related to risk management of natural hazards and the implementation of appropriate policies and actions for forecasting and environmental mitigation.

98. According to the report "Impact of Disasters in Latin America and the Caribbean, 1990-2011 - Trends and statistics for 16 countries" published by the UNISDR and OSSO Corporation in September 2013, the national systems for collecting data on disaster damages and losses should meet the following minimum requirements:

(a) Include extensive risk analysis: national data collection systems should strengthen the observation and collection skills at local levels of such risk analysis to be included in national inventories;

(b) Be systematic: data should be collected systematically throughout the year to allow temporal analysis and provide a complete picture of the manifestations of risk;

(c) Be comprehensive: in addition to collecting data on basic effects on people and housing, an inventory of the damage and losses in all sectors should be done: health, infrastructure, education, agriculture, etc.;

(d) Provide an economic estimation of damages and losses, including the impact on various sectors;

(e) Ensure regional breakdown of the damages and losses by major disasters and their aggregation at local level. This information is often scattered in different sources without standard formats to facilitate accessibility and systematization. When making the inventory of affected people during major disasters, it is recommended to design the data collection so that a reference to local administrative levels can be included.

99. It is necessary to cooperate with other government agencies to get up-to-date and timely information. A national statistical and geographical information system that includes economic, demographic and social, environmental and geographic information but also information on government, public security and administration of justice, will allow addressing civil protection holistically and generating useful information for disaster prevention and management.

100. Incorporating disaster risk management to development planning may help to revert the tendency of increasing losses and damages from disasters driven by economic development, population growth and rapid urbanization. Decisive action can save lives and properties. However, many developing countries do not have the tools, experience and resources needed to anticipate the potential impact of extreme natural events when making their investment decisions.

101. There is a need for better involvement of national statistical offices. This would be useful to:

(a) Agree on common classifications and definitions on extreme events and disasters;

(b) Agree on terminology and typology of disasters for statistical purposes;

(c) Exchange good practices and innovative approaches in supporting disaster preparedness with official statistics;

(d) Define which statistics are the key to disaster analysis and preparedness;

(e) Define how to improve national statistical offices' involvement in this area and the availability of official statistics;

(f) Develop international recommendations on measuring extreme events and disasters and using official statistics for this purpose.

102. There are innovative approaches and best practices in the use of official statistics to increase disaster resilience such as Demographic Explorer for Climate Adaptation (DECA) in Indonesia. This tool allows incorporating various official statistics and other data including census and social statistics in spatial analysis of climate change. The tool could be developed further for adoption in other regions.

103. Further work to improve the statistical description of the occurrence and impact of disasters should include the following:

(a) Defining processes for responding to disasters;

(b) Setting up and maintaining a collaborative website for information exchange;

(c) Regulating and promoting the use of mobile devices to implement early warning systems to the population;

(d) Regular publication of statistics and indicators related to disasters.

104. The information management during an emergency is a crucial part of any effective and timely humanitarian assistance operation. A strong information management network is needed to support emergency coordination. It requires processes to collect, analyze, and share information on economic situation and the environment among various organizations. The network should include representatives of people affected by the emergency, aid agencies, government and media. Information should be presented in easy to use formats such as maps or tables to support rapid decision-making at all levels.

105. As a conclusion, regional meetings would be very useful to exchange experience, join the efforts of various organizations and contribute to the global initiatives in this area.

United Nations ECE/CES/2015/10

Economic and Social Council

Distr.: General
23 March 2015

Original: English

Economic Commission for Europe

Conference of European Statisticians

Sixty-third plenary session
Geneva, 15–17 June 2015
Item 6 (a) of the provisional agenda
Outcomes of the in-depth reviews carried out by the Conference of European Statisticians Bureau

In-depth review of process-oriented approach to statistical production

Note by the Turkish Statistical Institute

Summary

The present note is the in-depth review paper on the process-oriented approach to statistical production. The Bureau of the Conference of European Statisticians conducted the in-depth review at its meeting in February 2015. The purpose of the reviews is to improve coordination of statistical activities in the region of the United Nations Economic Commission for Europe, identify gaps or duplication of work, and address emerging issues.

The note summarises international statistical activities related to the process-oriented approach to statistical production, identifies issues and challenges, and makes recommendations for possible follow-up work.

The outcome of the review is provided in document ECE/CES/2015/10/Add.1.

GE.15-06099 (E)

1506099

Please recycle

I. Executive summary

1. Today's statistical organizations are facing many challenges such as rapidly changing technologies, increasing demands of the public for timely, relevant, up-to-date statistics and decreasing budgets. These factors put pressure on producers of official statistics to employ more skilled staff and to have better IT infrastructure. National statistics offices (NSO) also need to decrease the burden put on respondents through surveys. Therefore, producers of official statistics start looking for alternative sources of data, such as internet and other Big data sources. In order to gain a sustainable competitive advantage NSOs need to modernize the statistical production. As part of the modernization efforts, process-oriented approach to statistical production has become quite popular in recent years among NSOs as well as international organizations.

2. In process-oriented organizations the focus is placed on business processes, improvement of interdepartmental and cross-functional interaction. The goal is to optimize the execution of the whole process rather than optimizing parts of it. This can be achieved by a thorough understanding of end-to-end processes and production system as a whole.

3. The aim of the in-depth review is to take a closer look at the NSO's organizational structures, their approach to process management and process integration. Country practices, issues and challenges met while implementing the process-oriented approach and lessons learned are also included in this in-depth review.

4. In order to evaluate the process-oriented approach in official statistics industry, TurkStat prepared an online survey to measure the NSOs' tendency toward process-oriented statistical production. The survey consists of 28 questions. The questions are mostly Likert type questions. The survey was sent to statistics offices of the member countries of the United Nations Economic Commission for Europe (UNECE) and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). In total, 31 countries out of 95 responded to the survey; a list of these NSOs is provided in the Annex.

5. Various dimensions of process orientation were taken into account in the survey and questions were asked to determine how NSOs rate themselves in these dimensions. Based on the findings of the survey, it would not be wrong to say that most organizations which responded to the survey have a vision to move towards a more process-oriented statistical production. However, it was also seen that, even the organizations which are most committed to streamlining the statistical processes have not completed statistical workflow management systems, the end-to-end standardisation, orchestration and automation of statistical processes.

6. The paper summarizes the findings of the survey reflecting the overall situation of the responding organizations, along with specific selected country experiences regarding the implementation of process-oriented approach. There could be a non-response bias in the survey results, since only one third of countries responded to the survey; i.e. there might be meaningful differences between the answers of respondents and the potential answers of non-respondents. For instance, countries which responded to the survey might be more advanced in process orientation.

II. Introduction

7. The Bureau of the Conference of European Statisticians (CES) regularly reviews selected statistical areas in depth. The aim of the reviews is to improve coordination of statistical activities in the UNECE region, identify gaps or duplication of work, and address emerging issues. The review focuses on strategic issues and highlights concerns of

statistical offices of both a conceptual and a coordinating nature. The current paper provides the basis for the review by summarising the international activities in process-oriented approach to statistical production, identifying issues and problems in this approach, and making recommendations on possible follow-up actions.

8. As a result of technology revolution and organizational changes, the organizations today are under the pressure of transforming and modernizing their processes and technologies to meet new demands. Moving from the traditional current state to a more process-oriented organization is a complex, costly and time consuming effort. It is costly in terms of the time it takes, the investments that need to be made in machines and tools as well as skilled labour.

9. The capability of management to orchestrate the individual components of the system – the IT department, the subject matter departments, the business analysts and others involved in the production process – is the most important factor for successful implementation of process management. It is essential that organization has a vision, strategy and strong commitment from the leadership to move in that direction.

10. This paper summarizes the experiences of NSOs with regard to process orientation. The following section III introduces types of organizational structures, definitions of stovepipe and process-oriented approach and discussions in the literature with regard to these approaches. Section IV summarizes information received on the modernization activities of international organizations. Section V describes country practices using the results of the survey and provides some specific examples of the implementation of process-oriented approach within NSOs. Section VI describes issues, challenges and the difficulties met by NSOs while implementing a more process-oriented approach in statistical production. The last section makes proposals for the way forward.

III. Attributes of organizational structures

A. Organizational structure types

11. The organizational structure defines how people in an organization are grouped together to achieve its goals. The organizational chart shows the structure of organizations and specifies the hierarchy of the organization, including who reports to whom.

12. In organization theory the basic types of organizational structures are defined as functional, divisional and matrix organizations. Definitions of these structures are as follows:

13. Divisional structure: A division is a collection of functions which produce a particular product. The divisional structure or product structure consists of self-contained divisions. This type of structure is closer to stovepipe structuring, where units are based on statistical domains, responsible for production of a certain product.

14. Functional structure: In functional organizations units are based on functions. In case of NSOs, these functions could be specified as data collection, processing, dissemination etc.

15. Matrix structure: This type of structure is a mix of functional and divisional organizational structure, usually with dual reporting lines. J. Galbraith says "A matrix is a type of organizational structure that is built around two or more dimensions, such as

functions, products or regions, and in which people have two bosses."[1] Matrix is considered as a more suitable structure for process-oriented production; it also supports the organizations in moving to that direction.

16. These three, most common basic types of organization were used to classify the organizational structures of NSOs. Although divisional structure is associated or matched with stovepipe organization; and matrix structure is associated with process-oriented organization; the match is usually not exact but rather it is based on some degree of overlap. Process-oriented and stovepipe structures generally appear as an additional layer on top of the existing structure and can be observed in the actual functioning of the organization.

B. Stovepipe organization versus process-oriented approach

17. The definition for "stovepipe organization" from Wikipedia[2] is as follows:

"A stovepipe organization has a structure which largely or entirely restricts the flow of information within the organisation to up-down through lines of control, inhibiting or preventing cross-organisational communication. Many traditional, large (especially governmental or transnational) organisations have, or risk falling into having, a stovepipe pattern. Intelligence organisations may deliberately adopt a stovepipe pattern so that a breach or compromise in one area cannot easily spread to others."

18. The definition of "process-oriented organization" is as follows[3]:

"An organization that emphasizes process as opposed to hierarchies, a process-oriented way of thinking, outcomes and customers."

19. The metaphor of stovepipes and silos in government has been around for a long time. It is argued that these structures bring isolationism within organizations and create an environment that limit organizations' ability for seamless production. Stovepipe systems result in a sub-optimal solution where parts may be improved without taking the whole functioning into consideration. The whole functioning of the organization may be improved or degraded as a result. Also, interdepartmental competition might result in an "I win, you lose" type of behaviour which would negatively impact the overall performance of the organization.

20. Stovepipe and silo organizations share a common characteristic: the left hand does not know what the right hand is doing. The symptoms of the silo effect are easy to recognize: lack of cooperation, internal competition, breakdown in communication, duplication and redundancy of work. On the other hand, a silo can become useful if they are used to concentrate on well-framed, truly separate issues. In fact, silos are necessary in some secure facilities, such as intelligence organizations.

21. Stovepipes and silos may exist no matter how the organization is structured. Therefore, looking for a structural solution for silos may not always be the right approach. Creating bridges across silos, improving communication between departments and ensuring that they are working efficiently toward the same goals are more important than the structure of the organization. If there is an organization wide encouragement to work well across divisions, then silos could disappear. In addition, process improvement and re-engineering also bring a widespread change in the organization and organizations move toward a matrix or process based functioning.

[1] "Designing matrix organizations that actually work", Jay R. Galbraith, Wiley 2008, page 3.
[2] http://en.wikipedia.org/wiki/Stovepipe_(organisation)
[3] http://en.wikipedia.org/wiki/Business_process_orientation

C. Dimensions of process orientation

22. As it was mentioned in previous sections of this paper, process-oriented organizations cannot be defined with a particular type of structure, but there are certain characteristics that make organizations process-oriented. These characteristics make up the dimensions of process orientation for organizations. Some of the most important dimensions are evaluated below.

1. Organizational structure

23. The discussion on alternative forms of organization focuses on the idea that the best structure supports the agility of organization and enables an organization to learn faster, execute better and change more easily. Even though process-oriented organizational structure is not clearly specified or classified among the types of structures in organization theory, there are some factors that help make an organization a process-oriented one. Process-oriented organizations focus on the optimal coordination and operation of the processes, there is cross-process integration so that the structure and processes are well aligned. The organizational structure of process-oriented organizations may vary with process management as an additional dimension to the structure.

24. Matrix structure is suggested as a suitable structure for process-oriented organizations. It groups employees both by function and division and manages individuals with more than one reporting line. This structure combines two different organizational approaches that coexist, for example silos and process-oriented activities. Matrix structure allows breaking traditional vertical silos of product and geography, to deliver work processes across the whole business more effectively and to be able to respond more flexibly.

25. In his book *Designing Matrix Organizations That Actually Work* Jay R. Galbraith[4] says "Organizational structures do not fail, but management fails at implementing them successfully." He argues that the matrix has become a necessary form of organization in today'. business environment. According to Galbraith, a complete design of the matrix organization aligns structure, goals, processes, rewards and people practices.

26. There may also be some difficulties in implementing the matrix structure. The structure is based on dual focus and dual responsibility, but dual reporting lines could blur the reporting relationship, bring some conflict, make coordination more difficult and lead to lower productivity. When there are multiple supervisors, there could be multiple and conflicting agendas and lack of clarity with priorities. This could be confusing for middle management and employees.

2. Process identification and documentation

27. One of the first steps in becoming a more process-oriented organization is to identify and document the processes within the organization. Only that allows analysing processes, monitoring process performance and taking the necessary measures to correct and improve processes. Process optimisation can be done when the problem is identified and the goals are defined and set.

3. Information technologies

28. Information technologies are an essential component of process management. "As the key processes were identified and their objectives determined, the company began to

[4] "Designing Matrix Organizations That Actually Work", Jay R. Galbraith, Wiley 2008

think about how information technology (its own and from other providers) could enable and support the processes. (Davenport & Short 1990)"[5].

4. Leadership and process ownership

29. Another important factor is the support and commitment of the management and senior executives. Process-oriented approach cannot be implemented without leadership. Management's commitment is essential for promoting a culture based on teamwork and collaboration across units. Process focused senior executives translate plans into process performance requirements rather than functional assignments.

5. Organizational culture

30. Organizational culture and organization wide understanding of process management requires focusing on the horizontal flow of work rather than on vertical hierarchies of control and communication. Also organization's culture of performance measurement needs to shift from individual recognition to process excellence.

31. Strong teamwork culture is an element of process-oriented organizations. Those organizations need to have or need to develop a culture aligned with their processes to have good coordination within and across process teams inside the organization.

32. Staff's awareness of processes and use of process terminology in everyday work is also an indicator of process-oriented organizational culture.

IV. International activities relating to process orientation of statistical production

A. UNECE, Conference of European Statisticians

33. Since 2010, the High-Level Group for the Modernisation of Statistical Production and Services (HLG) promotes standards-based modernisation of statistical production and services aiming at improving the process of statistical production. The mission of HLG is to oversee development of frameworks, and sharing of information, tools and methods, which support the modernisation of statistical organizations. The aim is to improve the efficiency of the statistical production process, and the ability to produce outputs that better meet user needs.

34. The High-Level Group has produced a strategic vision, which was adopted by the CES in June 2011, and a strategy to implement that vision, which was adopted by the CES in June 2012.

35. HLG defined its strategy in two directions:

(a) Statistical output: New and better products and services more tuned to the way the world is operating today, and created from a global perspective. This will help us to stay relevant;

(b) Production methods: Different and better processes and methods tuned to delivering our products at minimal cost with greater flexibility and in cooperation between institutions. This will help us to improve efficiency and effectiveness.

[5] "The New Industrial Engineering: Information Technology and Business Process Redesign" Thomas H. Davenport, James E. Short, MIT, June 1990

36. The strategic vision of HLG states that "Each statistical organization is a factory of statistical information. Together these statistical organizations form the 'official information' industry. Like any established industry, the production of official statistical information should have its own industrial standards. On the one hand, this will provide a necessary foundation for development and exchange of the means of production among the statistics producers, and potentially create a market of commercial interest to our benefits. On the other hand, this will consolidate the use of our statistical outputs in the global information community, making them readily accessible, interpretable and comparable".

37. Four modernization committees are now working under HLG to achieve the HLG strategy. These modernization committees are: Framework and evaluation, Production and methods, Products and sources, and Standards.

B. ESCAP, Committee on Statistics

38. The ESCAP Committee on Statistics established the Strategic Advisory Body for the Modernization of Statistical Production and Services in Asia and the Pacific SAB-AP in December 2012. The main objective is to drive and support changes towards the modernization of statistical products and services though developing a regional strategy for the Asia-Pacific, mobilizing financial and human resources, acting as a regional voice on the issue of modernization, and providing strategic direction to the work of experts groups addressing specific issues related to modernization.[6]

39. SAB-AP aims to raise awareness and build capacity related to concepts, methods and standards to support national efforts in modernizing statistics. These efforts also include the use of non-traditional data sources, such as Big data sources to produce official statistics.

40. SAB-AP works in regular consultation and coordination with related initiatives undertaken in other regions, notably HLG and its modernization committees. Taking into account the regional perspective, it will support the implementation of standards developed by HLG, such as the Common Statistical Production Architecture (CSPA), the Generic Statistical Business Process Model (GSBPM) and the Generic Statistical Information Model (GSIM).

C. European Commission

41. The European Statistical System (ESS)[7] functions as a network in which Eurostat's role is to lead the way in the harmonization of statistics in close cooperation with the national statistical authorities.[8] The ESS Vision 2020[9] builds upon a holistic approach to reach quality and efficiency gains. It embraces the opportunities provided by the digital transformation and emerging data sources; puts quality as an overarching element in the statistical production process; suggests new modes of collaboration and emphasizes the importance of dissemination and user engagement to drive continuous improvements. In this vision, the focus is placed on the mechanisms for collaboration and capacity-building

[6] http://www1.unece.org/stat/platform/display/msisap/SAB-AP

[7] The European Statistical System (ESS) is a partnership between the EU's statistical authority, i.e. the Commission (Eurostat), and the national statistical institutes as well as other national authorities responsible for the development, production and publication of European statistics in member nations.

[8] http://ec.europa.eu/eurostat/web/european-statistical-system/overview

[9] http://ec.europa.eu/eurostat/documents/10186/756730/ESS-Vision-2020.pdf/8d97506b-b802-439e-9ea4-303e905f4255

as well as on the changes that need to be made in the infrastructure and supporting frameworks to create a statistical system that is "fit for the future".

42. Key objectives of the ESS modernization initiatives are to improve quality and branding of the products; improve innovation and agility in producing statistics and to improve the overall efficiency of statistical production in Europe.

V. Country practices

43. In order to evaluate NSO's approach to process-oriented statistical production, and include the findings in this in-depth review TurkStat undertook a survey in November 2014. An on-line questionnaire was prepared and sent out to statistics offices of 95 UNECE and UN-ESCAP member countries. TurkStat shared the draft questionnaire with the members of the Modernisation Committee on Standards to receive their feedback prior to sending it.

44. The survey contains 28 questions measuring different dimensions of process-oriented approach, such as organizational structure, documentation of processes, process modelling, process ownership, organizational work culture and use of IT as an enabler of process management. The response rate to the survey is 32 per cent, 31 out of 95 NSOs responded to the survey. Since the response rate is not very high, there could be a non-response bias in the survey; i.e. there might be meaningful differences between the answers of respondents and the potential answers of non-respondents. For instance, countries who responded to the survey might be dealing with the process modelling and process standardisation more than the ones who did not respond to the survey (or vice versa). However, the survey responses provide a good basis for analysis.

A. Results of the survey on the "Process-oriented Approach to Statistical Production"

45. Organizational structure is one of the several dimensions of process-oriented organization. Three main types of structures are determined and used in this study to categorize the organizations (see section III. A. for definitions and types of organizational structures).

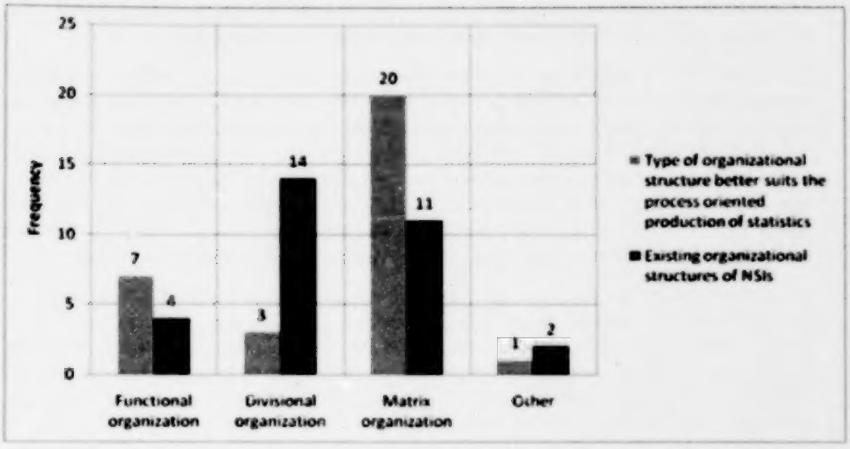
46. In the survey a general question of "*What type of organizational structure better suits the process oriented production of statistics?*" was asked. Two thirds of NSOs who responded to the survey said that the matrix organization suits the process-oriented production better. Functional organization and divisional organization was chosen by only one third of organizations (see Chart 1). An NSO answered the question as "It depends on the organisation itself and what fits with tradition and culture and what one would like to achieve with the process orientation." NSOs also consider cross-process integration as an important element for efficient statistical production in addition to the organizational structure.

47. In order to get information about the organizational structure of NSOs, the survey asked *whether the organization was structured functionally, divisionally, matrix or in another form* (see Chart 1). Most NSOs said that their organizational structure is divisional, i.e. units are based on statistical domains, products or regions with vertical orientation. Second most widely seen structure among NSOs was the matrix structure. NSOs explained their matrix structure as a mix of functional (such as methodology, data collection, dissemination and IT) and divisional structures (statistical domains, subject matter departments). However, this does not necessary indicate process orientation and it was not

clearly stated whether there are dual reporting lines within the structure. Only a few NSOs classified their organizations as functionally structured.

Chart 1

Organizational structures that NSOs reported as better suiting the process-oriented statistical production; and existing organizational structures of NSOs (number of responses)



48. A Likert type question of "*your organizational structure is derived from organization's business processes*" was asked on a four point scale from strongly agree to strongly disagree. Approximately two thirds of NSOs (23 of 31) either *strongly agree or tend to agree* that their structure is derived from processes; and eight organizations *disagree* with the argument that their organizational structure would be derived from processes.

49. Another important aspect of process orientation is identification and documentation of key business processes. In order to manage the processes NSOs need to clearly define and document the statistical processes that are performed within the organization. Based on the findings from the survey, almost all of NSOs *strongly agree or tend to agree* that their processes are clearly defined. When it comes to process documentation and updating the documentation most organizations only *tend to agree* that this is done.

50. Organizational culture has a big impact on process orientation. Problems during the implementation of process-oriented approach usually arise due to the work culture. Process-oriented organizations typically have an established teamwork culture. Process orientation also requires efficient flow of information so that the processes are integrated across different departments of the organization. In the survey, NSOs were asked if their organization has a strong teamwork culture, and whether the information flow through statistical processes is efficient. Most NSOs *tend to agree* that their organization has a strong teamwork culture with only a few NSOs indicating that they *strongly agree*.

51. Process ownership is seen as another dimension of process orientation. When NSOs were asked if there is any responsible unit or senior executive responsible for process management, half of the NSOs said that there are assigned process management responsibilities and the other half said there are none.

52. Statistical business process models are used by most NSOs to describe statistical business processes. When NSOs were asked if they use a statistical business process model to map their processes, 24 of 31 organizations answered "yes" to this question. Among the

ones who use a process model, 17 organizations use either GSBPM or country version of GSBMP, whereas 7 countries use their own process models.

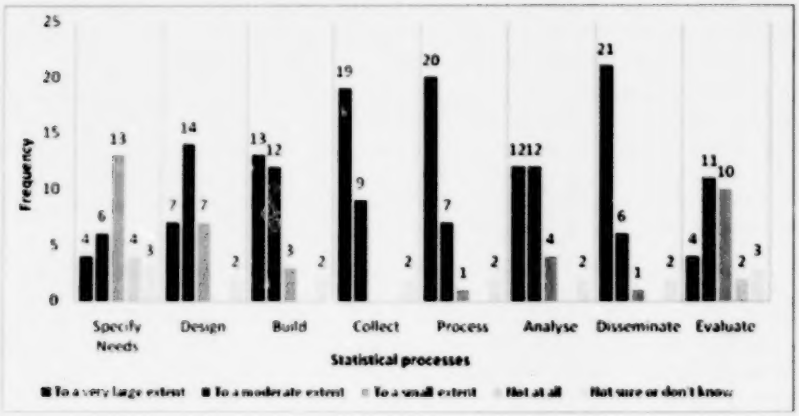
53. High level modelling of statistical business processes is done using GSBPM or NSOs own models. The business process model and notation (BPMN) software was used as a tool for process modelling by one third of the NSOs.

54. Information technology is an essential ingredient of process orientation. IT is needed as an enabler of process management, to model, standardise, improve and automate the processes. 24 out of 31 NSOs use IT as an enabler of process management.

55. NSOs were also asked to what extent they use IT as an enabler of process management for each of the eight phases of GSBPM[10] as well as for support processes on human resources, finance and training. Again a Likert type question was used, scaling from "to a large extent" to "not at all". NSOs reported using IT from *a moderate extent* to *a large extent* as enabler of process management for both statistical and non-statistical processes. The Likert scale score for statistical processes (GSBPM phases) is relatively higher than for non-statistical processes i.e. NSOs use IT for statistical processes *to a very large extent* while they use it for non-statistical processes *to a moderate extent* (See Charts 2 and 3).

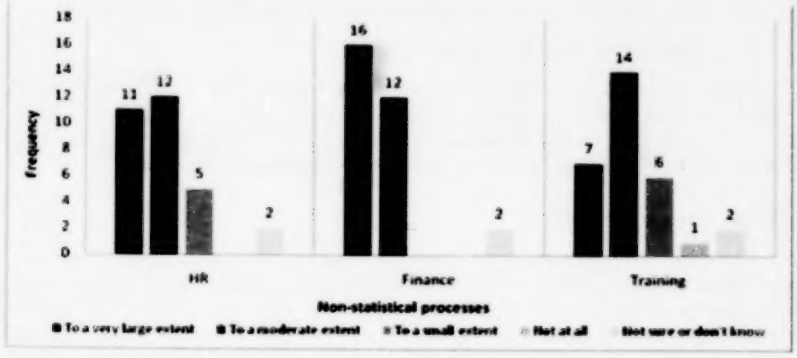
56. Most NSOs use IT *to a large extent* for the work process phases called "collect", "process" and "disseminate" (as in GSBPM), and less for other work process phases. IT is used to a lesser extent in "analyse" phase compared to the other three operational phases. In "build" and "analyse" phases IT is generally used from *a moderate to large extent*. In "design" and "evaluate" phases most NSOs indicate that IT is used *to a small to moderate extent*, in "specify needs" phase IT usage goes down to a small extent (see Chart 2).

Chart 2
Use of IT as an enabler of statistical business processes



[10] GSBPM phases: Specify Needs, Design, Build, Collect, Process, Analyse, Disseminate, Evaluate.

Chart 3
Use of IT as an enabler of non-statistical processes



57. Customer/user orientation is a very important dimension of process-oriented work. User satisfaction surveys are used to get users feedback on products and processes and to improve them. Almost all responding NSOs regularly carry out user satisfaction surveys and report that the survey results have an impact on products or processes. Mainly the results of user satisfaction surveys impact dissemination types and channels, and also the product portfolio.

58. Process performance measurement is done by all NSOs to some extent. Almost all of NSOs collect process performance data either periodically or from time to time. Performance indicators are specified from a small to moderate extent, and these indicators are based on both organization's goals and customer requirements.

59. More than half of the organizations make use of process improvement methodologies such as International Organization for Standardization (ISO), six sigma, Total Quality Management (TQM) and European Foundation for Quality Management (EFQM).

60. A direct question about process orientation was asked to NSOs. Two thirds of NSOs *tend to agree or strongly agree* that they have a process-oriented approach to statistical production; while one third of NSOs *disagree*. NSOs also mentioned that this approach helps to improve the quality of their products.

61. NSOs state that process-oriented approach and initiatives taken to standardise and improve the processes result in improvements in data collection, data processing and metadata systems. In addition, NSOs report that process orientation has reduced the cost of producing statistics.

62. More detail about NSOs' experience regarding the implementation of process orientation is provided in the following section of the document.

B. Implementation of process orientation, lessons learned from NSOs' experience

63. This section addresses the experience of selected NSOs in the following issues:

(a) How was process-oriented approach implemented in organizational structure?

(b) What was the impact of process-oriented approach on products and production?

(c) What were the difficulties met while implementing and applying the process-oriented approach?

(d) How did process-oriented approach impact organization's work culture?

(e) Lessons learned during the implementation.

64. The responses given to the above questions provide highlights in implementing a process-oriented approach in NSOs. This information could be useful for other organizations intending to move towards process-oriented organization of work. The section reports the responses of six NSOs who agreed to disclose their answers.

1. Australian Bureau of Statistics

65. Structural implementation: An important aspect was introducing functional specialisation for key phases of the statistical business process (e.g. "collect" and "disseminate") to serve the needs of all statistical programs within the Australian Bureau of Statistics (ABS). Other phases (e.g. "specify needs", "design", "process", "analyse" and "evaluate") are still conducted by subject matter statisticians but increasingly make use of shared statistical frameworks, methods, process patterns and processing platforms.

66. Impact on products and production: If ABS had not moved toward a process-oriented approach it would no longer be possible to produce the range of products ABS currently produces (across 177 statistical programs). A range of savings were made in regard to production. It also became more feasible, although still not easy, to manage the transition to updated technology within the statistical process, such as e-forms.

67. Difficulties while implementing: Transition of business activities to a process-oriented approach usually took longer, and proved more complex, than originally envisioned. Functions which had not been well delineated from each other previously needed to be formalised and separated. Analysis and discussion was required to clarify whether more generic processes and methods met the business needs of the specific statistical program to a sufficient level. Staff needed to be retrained, and redeployed in some cases, as their roles changed.

68. Impact on work culture: The transition period placed pressure on work culture. This was managed carefully via human resources strategy. Following the transition, staff generally found that their role included less manual tasks that were very detailed and routine. They had more time available for higher level tasks such as analysis and innovation. There was also more emphasis on different parts of the organisation working together in practice to achieve results compared with more "stove-piped" working arrangements in the past. In general the change in work culture was positive.

69. Lessons learned: A process-oriented approach adds value but a lot of care, cooperation and shared commitment is required across the organisation to design the new approach, manage the transition and achieve the desired outcomes in practice. Due to the extent of change required, a number of substantial steps toward achieving a process-oriented approach may be preferable in practice to seeking to achieve the transition in a single large step. Having achieved process orientation to a moderate degree ABS is now well placed to strengthen the approach.

2. The Census Bureau, United States

70. Structural implementation: Some organizational/directorate reorganizations were established to support a functional vs. survey centric view.

71. Impact on products and production: Recent initiatives to centralize the IT systems and create an enterprise system for data collection, processing, and dissemination of statistical data.

72. Difficulties while implementing: Institutional culture to view processes from an enterprise level vs. survey specific to meet the individual requirements.

73. Impact on work culture: Process orientation enabled employees to see similar processes once implemented to target potential areas for efficiency.

74. Lessons learned: The Census Bureau is in the midst of implementation, but one lesson learned is that this sort of change takes time and buy in from the top to the bottom of the organization.

3. Statistics Canada

75. Structural implementation: Statistics Canada undertook a major modernization project starting in 2009 that is entitled Corporate Business Architecture. Key principles are to be more efficient, robust and responsive to user needs. As part of the implementation (that is still ongoing) Statistics Canada identified several areas for improvement: aligning with GSBPM, centralizing specific functions (data collection, operations, IT), reducing the number of software/systems being built, and moving towards Service Oriented Architecture (SOA) and enterprise architecture. Statistics Canada initiated many modernization projects in waves to lead towards process improvement, and reorganized the organizational structure to support being more process-oriented.

76. Impact on products and production: Increased specialized expertise in collection, processing (business/social), IT, operations. Allows subject matter experts to focus on analysis and their area of expertise rather than operational activities. Financial resources that were saved due to being more efficient were reinvested in the organization's programs and to ensure ongoing quality maintenance.

77. Difficulties while implementing: Some resistance to change. Needed to ensure senior management support was unwavering. Significant investments were made in renewing computer systems and creating generalized tools for re-use.

78. Impact on work culture: The implementation of our modernization project created waves of concern when first introduced, but through senior management support and effective governance, modernization initiatives are moving forward towards full implementation.

79. Lessons learned: Unwavering senior management support is essential. It is important to explain to employees from the beginning why this is being undertaken, and what the impact will be. It is important to emphasize the ability of the organization to innovate through change, and that change can be positive. The communication is very important and never enough. Implementing change must be reinforced through project management rigour and monitoring. Appropriate governance, change management, prioritization and decision making must be put in place.

4. Statistics Finland

80. Structural implementation: By centralising all data capture (administrative data capture, survey operations) in a single unit; establishing the role of the process owner (Deputy Director General of Statistics Production) in the statutes.

81. Impact on products and production: Changes in the work processes and in the planning process (more centralized approach to development work).

82. Difficulties while implementing: It is not possible to implement the changes overnight, the establishment of the new organisational structure takes time and is done in steps.

83. Impact on work culture: Difficult to say yet, probably improved understanding of the work of colleagues in other units.

84. Lessons learned: To engage the whole organisation is challenging, especially the changing role of former domain-specific units has created tensions.

5. Statistics Norway

85. Structural implementation: Data Capture and Dissemination

86. Impact on products and production: Quality improvements across domains using the same process.

87. Difficulties while implementing: The individual statistics did not always feel that their individual needs were being met and/or prioritised enough.

88. Impact on work culture: More meetings and documented routines for cross-cutting processes.

89. Lessons learned: There needs to be more documentation of cross-cutting processes and of the interfaces between these and the rest of the organisation. New meeting places (physical and/or virtual) need to be established to discuss and plan cross-cutting issues.

6. Turkish Statistical Institute

90. Structural implementation: TurkStat designed its own version of statistical business process model using GSBPM. Procedures/methods that are used, step by step work flows, inputs and outputs of sub-processes, owners of the processes, the number of people required to do these tasks, software tools and other relevant metadata were collected from the subject matter departments. Documentation of processes and relationships between the processes is done according to the model; work flows are being modelled using a process modelling tool. The organisational structure was reorganised according to the TurkStat's Statistical Business Process Model. New functional divisions were created to coordinate cross cutting processes such as: metadata, standards, data collection, data analysis and administrative register systems. After the process-based reorganization was done, problems in the production processes started to be more openly discussed and evaluated.

91. Impact on products and production: Data production and dissemination systems have been standardised and new systems are built. A Data Documentation Initiative (DDI)[11] based IT tool was created and used for data collection and metadata. All business surveys and most household surveys moved into this new data collection environment so that all surveys would be using the same IT tool for data collection. Development of a new data processing and analysis module to be added to the new data collection tool started.

92. In 2012, a decision was made to standardise and maintain the metadata in one place. Code lists were brought together from all surveys. The variable names were listed and standardized according to the internally defined standard naming conventions. A catalogue of variable names was created for common variables. Control points were added to the processes in organizational structure to make sure that surveys comply with the new standards.

[11] Data Documentation Initiative (DDI) is an effort to create an international standard for describing data from the social, behavioral, and economic sciences; and expressed in XML.

93. As a result of these standardisations and the new systems, timeliness and effectiveness of data collection process are improved.

94. Process metadata became available to create new reports for senior management to help with their decisions.

95. Difficulties while implementing: Trying to change the culture of an organisation takes a long time. Becoming a process-oriented organization requires good coordination and strong teamwork culture within and across departments. The subject matter departments resisted the change first because of the extra work load during the transition period, but after seeing the benefits of the new systems and tools they started to support the change.

96. Impact on work culture: The senior management of the organisation supports the work on process management. However, the staff thinks that process documentation and standardisation creates a lot of extra work for them. Change in habits and work culture slowly began. Although there was some resistance to use new standard IT tools in the beginning, staff have become more adaptive to change.

97. Lessons learned: Think big but take small steps. The purpose of changes in organizational structure need to be communicated to the staff very well. The changes that are going to be made in the IT infrastructure have to be scrutinized and planned in detail before taking any steps. The departments have to be ready for more cooperation and teamwork. Change management is crucial to orchestrate the activities.

VI. Issues and challenges

A. Challenges at the international level

98. International models such as, GSBPM, GSIM, CSPA, Generic Activity Model for Statistical Organizations (GAMSO), Statistical Data and Metadata Exchange (SDMX) and DDI provide a base for standardisation of processes, metadata and statistical production systems in NSOs.

99. There is a widespread effort across NSOs to standardise processes and follow a more process-oriented organization of work. These efforts benefit from the internationally developed models for standardising and modernising statistical production. Adoption of these frameworks by statistical organizations improves the common understanding and alignment that is needed for joint development, sharing and re-use of components. However, the challenge is that development, adoption and implementation of these models takes time. NSOs are at different stages of modernization which could make the sharing and re-use of common tools difficult. Furthermore, it takes time to get feedback from countries on new standards and models so as to develop their feasibility.

B. Challenges at the national level

100. The experience of NSOs shows that they face many problems when trying to become more process-oriented. Achieving a global state of process-oriented official statistics industry would not be easy when each individual NSO has problems in standardising, streamlining and automating their processes.

101. The replies of NSOs to the question: "*What were the difficulties met while implementing and applying the process-oriented approach?*" provide insight into challenges met and help to identify key characteristics of the problems. NSOs reported

about many kinds of difficulties when improving process orientation, such as cultural and management issues, communication problems and lack of resources in terms of financial resources and skilled labour.

102. One of the key challenges in the transformation process is the institutional culture. There may be some resistance to change due to the necessity adapt to new roles and learn new tasks. Staff may find it difficult to view processes from the enterprise level as opposed to statistical domain level. The changeover period may be burdensome and demanding.

103. Another problem is how to manage the processes between different departments and how to clearly distribute authority. Reporting lines might get blurred in process-oriented structures (e.g. dual reporting lines in a matrix) and this could cause practical difficulties and duplication of effort. Senior management's support, clear communication among staff and a strong teamwork culture is essential to overcome these problems.

104. NSOs emphasized the lack of resources. Renewing the existing organization takes considerable amount of time and resources. Significant investments need to be made in IT systems; new skills are required both for statisticians and IT specialists. Renewing IT tools and retraining staff because of changing roles is costly and challenging.

VII. Conclusions and recommendations

A. Conclusions

105. There are intensive efforts at the national and international levels to modernize statistical production, many of these stressing the importance of process-oriented approach to statistical production.

106. In practice, the organization types of NSOs vary and different structures can be suitable for statistical production. Each NSO can design its organizational structure and processes in ways that match with their needs and priorities.

107. Process-oriented structuring is important, but changing the organizational structure may not be enough for introducing process orientation. It also requires fundamental changes in the work culture.

108. Process oriented approach gives employees a new perspective on how to do their work. Employees start looking at processes from a wider, institutional level as opposed to survey specific level. Process-oriented organizations start seeing similar processes as a potential area for standardisation (such as data collection, data editing, data processing and dissemination), whereas they used to be independently maintained and developed by each subject matter area.

109. The survey showed that data collection and dissemination are the process phases that NSOs most commonly standardise and automate. GSBPM or a national version of GSBPM is widely used by NSOs for process modelling, whereas the use of BPMN tools is not very common across NSOs. Many NSOs noted that they have not yet completed the standardisation and automation of all processes. Some NSOs mentioned that they have started process standardisation, and some indicated that they are in the middle of transforming the processes. Some had not yet started because of lack of time and resources.

110. The NSOs' experience shows that moving towards process orientation is a complex and difficult undertaking. The following provides a summary of issues that NSOs faced when implementing process orientation:

- Better understanding and more documentation of cross-cutting processes are needed.

- New skills are required for statisticians as well as the IT specialists.
- More investments have to be made to develop common IT tools for sharing and re-using.
- Better communication is necessary across organizational units.
- Teamwork is essential for process management.
- Commitment of staff and senior management is important.

111. Regardless the challenges, the work was considered worthwhile. If there is an organization wide support for change, the necessary investments and trainings are done, and if the organizational culture is open for change then the organization can become more agile and function more effectively and efficiently.

112. NSOs reported on many significant benefits as a result of developing a process-oriented approach to statistical production. The increased standardisation helped to reduce costs, allowed subject matter experts to focus on analysis rather than operational activities, reduced routines, improved timeliness and effectiveness of data collection. Financial resources that were saved could be more efficiently reinvested in the organization's programs to enable maintaining the required wide range of different statistical products and improving quality across statistics. The change helped to develop process phase-specific skills, e.g. IT skills which make a transition to updated technology more feasible.

B. Recommendations

113. It is not easy to make a clear definition of a "process-oriented NSO". Therefore, it is also a huge challenge to develop a process-oriented approach to statistical production. A Task Force to determine fundamental characteristics of process-oriented statistical production and basic requirements to achieving it would be valuable. The group could produce a simple and actionable "to do list" or a "check list" to be recommended to NSOs. NSOs could then use these resources as a guideline when aiming for a more process-oriented way of working.

114. More efficient sharing of experience would support those NSOs wishing to move forward. A wider compilation of NSOs' experience in the modernization and re-engineering of statistical production towards process orientation could be made and shared using a wiki knowledge base. Studying further the experience of NSOs that are applying a process-oriented approach to statistical production would also support the work of the suggested Task Force.

115. Collaboration across subject matter departments as well as the functional departments in organizations remains as a specific challenge and should be further enhanced at the national level. Therefore, practical advice on how to improve communication and collaboration to enable a well-functioning process-oriented approach could be discussed at the international level.

116. Increased collaboration between NSOs would be essential for improving processes and creating synergies to develop common methods, tools and systems. Efficient international collaboration would help to reduce the need to re-invent the wheel and to avoid duplication of effort across NSOs. To launch a more active discussion on the topic, the process-oriented approach to statistical production could be added to the list of possible topic for upcoming CES seminars.

117. The Bureau is invited to consider the way forward including:

(a) Determining characteristics and requirements of process orientation with a simple and actionable "to do list";

(b) Carrying out a compilation of NSO experience covering more countries and collecting material to a wiki knowledge base;

(c) Discussing the topic at a future CES seminar to find synergies across countries and identify additional areas for improvement, standardisation or automation of processes.

Annex

List of NSOs responded to the Survey on Process-oriented Approach to Statistical Production

1. Australian Bureau of Statistics
2. Bureau of the Census, USA
3. Central Bureau of Statistics, Israel
4. Central Statistical Bureau of Latvia
5. Central Statistical Office, Poland
6. Croatian Bureau of Statistics
7. Federal Statistical Office, Germany
8. Hungarian Central Statistical Office
9. Institut National de la Statistique et des Études Économiques, France
10. Institute of Statistics (INSTAT), Albania
11. National Statistical Committee of the Republic of Belarus
12. National Statistical Institute of the Republic of Bulgaria
13. National Statistical Office, Mongolia
14. National Statistical Office, Thailand
15. National Statistics Office of Georgia
16. State Statistical Committee of Azerbaijan Republic
17. State Statistical Office, the former Yugoslav Republic of Macedonia
18. Statistical Office of Montenegro
19. Statistical Office of the Republic of Serbia
20. Statistical Office of the Republic of Slovenia
21. Statistics Austria
22. Statistics Canada
23. Statistics Department of Economic Planning and Development, Brunei Darussalam
24. Statistics Estonia
25. Statistics Finland
26. Statistics Lithuania
27. Statistics Norway
28. Statistics South Africa
29. Statistics Sweden
30. The State Statistics Service of Ukraine
31. Turkish Statistical Institute